U.S. Army Research Institute for
the Behavioral and Social Sciences

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Techniques and Practices in the Training of Digital Operator Skills

Bruce C. Leibrecht
Northrop Grumman Corporation

Gregory A. Goodwin
U.S. Army Research Institute

Richard L. Wampler
Northrop Grumman Corporation

Jean L. Dyer
U.S. Army Research Institute

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Paul A. Gade

PAUL A. GADE, Ph.D.
Acting Technical Director

Michelle Sams

MICHELLE SAMS, Ph.D.
Director

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Technical review by

Martin Bink, U. S. Army Research Institute
J. Douglas Dressel, U. S. Army Research Institute

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14. ABSTRACT *(Maximum 200 words)*:

This report presents research on classroom training practices in Army Battle Command System courses. The investigation examined a sample of institutional courses using observation and classification techniques. Three learning theories—behaviorist, cognitive, and constructivist—guided the collection and analysis of data. Cognitive and behaviorist training techniques were observed somewhat more frequently than constructivist techniques. The frequency of training techniques depended on the type of course (operator vs. leader orientation), instructor style, and progression across days. The discussion offers potential improvements in the areas of training techniques, program of instruction, training environment, and instructional innovation. The report is intended for use by training designers and developers, digital trainers, and training managers working in institutional settings.

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Bruce C. Leibrecht
Northrop Grumman Corporation

Gregory A. Goodwin
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Jean L. Dyer
U.S. Army Research Institute

Infantry Forces Research Unit
Scott E. Graham, Chief

U.S. Army Research Institute for the Behavioral and Social Sciences
2511 Jefferson Davis Highway, Arlington, Virginia 22202-3926

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TECHNIQUES AND PRACTICES IN THE TRAINING OF DIGITAL OPERATOR SKILLS

EXECUTIVE SUMMARY

Research Requirement:

In support of Army transformation, the U.S. Army Research Institute's Infantry Forces Research Unit is conducting research addressing how to enhance the training of digitally equipped forces, including units using the Army Battle Command System (ABCS). Achieving digital proficiency involves complex training that must cope with demanding challenges. Given the widespread use of digital systems and the limitations on training resources and time, the Army must improve its digital training methods. This is important for training institutions, just as it is for tactical units. The current research, one phase of the larger digital training research program, was conducted to determine the techniques currently used to train digital skills and to identify the learning principles/theories represented by those techniques.

Procedure:

The research team observed a sample of ABCS training courses teaching basic system operating procedures at Fort Hood, Texas and Fort Benning, Georgia. Three learning theories—behaviorist, cognitive, and constructivist—shaped the observation methods. Observers used a structured protocol to capture data on the training environment, instructional activities, and training techniques in use. The resulting data were analyzed in the context of the three theories to characterize the state of digital training methods.

Findings:

Cognitive and behaviorist training techniques were observed somewhat more frequently than constructivist techniques. The frequency of training techniques depended on the type of course (operator vs. leader orientation), the instructor's style, and progression across days of training. Each training situation involved a somewhat unique mix of training techniques. Other innovative techniques observed included using experienced students as demonstrators, collecting ancillary handouts and digital media to distribute to students, and developing a sequence of practical exercises that reflected the sequence of events that Soldiers would encounter on a mission.The discussion offers potential improvements in the areas of training techniques, program of instruction, training environment, and instructional innovation. For example, greater use of constructivist and cognitive techniques may be warranted in some circumstances.

Utilization and Dissemination of Findings:

The findings and improvement options from this research can help training designers and developers enhance institutional programs of instruction. The ultimate payoff will lie in units that leverage digital battle command capabilities to enhance mission accomplishment. Major findings were briefed to the digital instructors at Fort Benning Georgia.

TECHNIQUES AND PRACTICES IN THE TRAINING OF DIGITAL OPERATOR SKILLS

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TECHNIQUES AND PRACTICES IN THE TRAINING OF DIGITAL OPERATOR SKILLS

Introduction

Under sweeping transformation initiatives, the Army is migrating toward total force fielding of digital command and control systems. In the vanguard of tactical digitization are the Army's Stryker Brigade Combat Teams (SBCT), marrying Army Battle Command System (ABCS) capabilities with new organizations and doctrine. The network-based architecture, while providing more informed situational understanding, brings new training challenges. For the next generation of digitization, the Future Combat Systems and the Ground Soldier System will provide the capability for leaders and small combat units to operate in a widely dispersed network-enabled environment—channeling, managing, assessing and exploiting information from numerous sources. Additionally, digital tools are evolving (e.g., Tiboni, 2003) to enhance decision-making by means of intelligent agents, embedded alerts, etc. Innovative training approaches are required to enable Soldiers, leaders and units to acquire digital knowledge and skills faster and retain them longer.

Background

Training Soldiers and leaders to operate and employ digital systems in combat conditions presents unique challenges. However, the actual training of system operations is akin to training any computer system. Operators must understand what they are viewing on the screen, how to interact with the interface, and the functionality available within the system. Trainers must be aware of learning strategies and cognitive principles in the design and delivery of digital training.

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) has been investigating and developing solutions for the training of ABCS skills over the last eight years for the four main components of the ABCS: the Maneuver Control System (MCS), the All Source Analysis System (ASAS), the Army Field Artillery Tactical Data System (AFATDS), and the Force XXI Battle Command Brigade and Below system (FBCB2). Table 1 lists these components and their functional roles, which revolve around the brigade echelon and below.

Table 1
Components of Interest from the Army Battle Command System

Component	Role
Force XXI Battle Command Brigade and Below (FBCB2)	Maneuver forces tool for command, control, communication, and navigation; feeds common operational picture
Maneuver Control System (MCS)	Primary battle staff tool for planning and controlling maneuver operations; main source of friendly picture
All Source Analysis System (ASAS)	Principal staff tool for planning and controlling intelligence activities; chief source of enemy picture
Advanced Field Artillery Tactical Data System (AFATDS)	Integrated tool for planning and controlling indirect fires; primary source of fire support picture

One line of this ARI research focused on developing digital training guidelines and proficiency assessment techniques for Force XXI units. Dudley, Johnston, Jones, Strauss, and Meliza (2001) described changes in behaviors and knowledge as 4th Infantry Division (Mechanized) (4ID) units adapted to digital systems. Dudley, et al. (2002) detailed the role of digital systems in accomplishing critical combat tasks at brigade and battalion levels. Meliza, Lockaby and Leibrecht (2003) established a framework for differentiating and ordering levels of digital proficiency. Leibrecht, Lockaby, and Meliza (2003a) examined capabilities, tasks, skills, and variables influencing digital performance with the FBCB2 system.

The ARI investigators also developed an FBCB2 exploitation tool to help leaders and trainers optimize digital training exercises (Leibrecht, Lockaby, & Meliza, 2003b). Later Leibrecht, Lockaby, Perrault, and Meliza (2004a) identified battle staff integration skills enabled by the ABCS, along with key proficiency targets and proficiency level discriminators. They also explored echelon differences and factors distinguishing digital from analog battle staffs. A digital staff training guide was developed, and the potential impact of Future Force capabilities on battle staff performance and assessment was analyzed (Leibrecht, Lockaby, Perrault, & Meliza, 2004b). Follow-on work described efforts to tailor the family of guides to evolving digital systems and progressive digital proficiency levels of ABCS-equipped units (Leibrecht, Lockaby, Perrault, Strauss, & Meliza, 2006). The cumulative outcome of these projects was a comprehensive digital proficiency architecture offering practical tools and techniques.

In the present research effort, we investigated digital training practices in Army classrooms and assessed them from the standpoint of theories of learning. Before describing the process of data collection and analysis, it would be helpful to discuss briefly the three primary learning theories that we chose—behaviorist, cognitive, and constructivist theories.

Behaviorism is an area of psychology that took root in the United States just after World War I. Although there are many behavioral theorists, the primary principles of this theory hold that learning should be measured in terms of changes in observable behaviors that result from quantifiable changes in environmental stimuli. Early behaviorists strongly opposed the study of any sort of mental event, but more recent behaviorists like Albert Bandura and Edward Tolman recognized that processes like vicarious learning and latent learning could not be explained unless some unobservable information processing was taking place (Schultz & Schultz, 2004).

The behaviorist approach to training applies especially to teaching new tasks because learning is best measured in terms of behavioral change. As Sanders (2001) explained, this theory views learning as a largely passive process in which exposure to the appropriate stimuli, reinforcement, and/or punishment leads to behavioral change. A key principle of behaviorism is that repetition of the stimulus and response (i.e., practice) strengthens learning and reduces decay.

The cognitive movement emerged in the 1960s and was in many ways a reaction to the refusal of most behaviorists to include mental events in the domain of psychology (Schultz & Schultz, 2004). Cognitive psychologists study human thought processes and they see the brain as a biological computer that assimilates, interprets, processes, and stores information. This theory regards the learner as an active participant in the learning process, organizing and assimilating new information into existing knowledge structure. It follows that the more the instructor can organize and present information in a logical fashion, the more easily the learner can assimilate the information. Using techniques such as advance organizers, analogies and mnemonics to relate new information to that already in the learner's knowledge base will facilitate learning.

Constructivism was developed not so much as a psychological theory but as an approach to training (Fox, 2001). In many ways it is a reaction to cognitivism but at the same time it shares many traits with that theory. Like cognitivism, constructivism is a theory about how individuals acquire, process, and store information; but unlike cognitivism, it sees learning as highly individual. Constructivism proposes that the way an individual understands and encodes new information is related to her/his unique history and personality. For example, if two people are asked to memorize strings of numbers, one may be a history buff who uses significant historical dates to help remember the assigned numbers while another might use his knowledge of baseball statistics to help remember the numbers.

Constructivism therefore questions the validity of pre-organizing material and requiring everyone to use the same training plan and mnemonics. Constructivist practitioners use training approaches known as problem-based learning, discovery learning, or experiential learning within a realistic task context (Ertmer & Newby, 1993; Kirschner, Sweller, & Clark, 2006). All of these learning approaches place the responsibility of organizing and making sense of the to-be-learned material on the shoulders of the learner. Constructivists believe that an instructor should provide minimal guidance to students and should function more like a coach, encouraging students to explore and find answers on their own.

While theories of learning are broad models of how we learn, they give rise to more specific principles of learning which are relationships that are always true under appropriate conditions (Merrill, 2002). An example of a principle of learning derived from cognitive theory is: "deep processing of information leads to better retention." Learning principles such as this then give rise to any number of specific training techniques such as specific activities that result in students having to process a concept at a deeper level. This transfer from theory into practical training techniques that can be used in the classroom is a challenging effort and it has given rise to the discipline of instructional design. As explained by Ertmer and Newby (1992), instructional designers attempt to translate learning principles derived from theory into practical training techniques and materials. What makes this process difficult is that theories of learning do not often address practical questions such as: do the instructional activities used need to vary according to the background and experience of the students, the task or topic being trained, or the duration of the training.

Although the field of instructional design is broad, Merrill (2002) has recently attempted to unify different theories and models in this discipline. According to Merrill, the most effective instructional design theories are problem centered and include four distinct phases of learning: activation of prior experience, demonstration of skills, application of skills, and integration of these skills into real-world activities. Merrill (2002) derived from these what he called the five first principles of instruction:

1. Learning is promoted when learners are engaged in solving real-world problems
2. Learning is promoted when existing knowledge is activated as a foundation for new knowledge.
3. Learning is promoted when new knowledge is demonstrated to the learner
4. Learning is promoted when new knowledge is applied by the learner.
5. Learning is promoted when new knowledge is integrated into the learner's world.

Merrill (2002) states that these principles were distilled from a number of design theories and models and so he believes that they represent a common core of learning principles. Interestingly, they were not drawn directly from the three theories of learning described above, yet elements of these three theories can be seen among his five first principles. For example, each theory advocates active participation and interaction (principle 4, see also Ertmer & Newby, 1993), but while behaviorists emphasize practice so that performance can be shaped with reward and punishment, cognitivists emphasize active learning to improve the encoding of memories, and constructivists emphasize active learning so that the learner can formulate his or her own understanding of the topic. Similarly, all three theories would agree that training should match the real-world performance a closely as possible (principle 5). Behaviorists say that environmental stimuli can guide and cue behaviors so different stimuli in practice and application degrade performance. Cognitivists say that environmental cues can serve to encode and later cue memories needed to successfully perform a task and constructivists say that realistic practice is the best way to encourage students to incorporate the learned task into their own knowledge structure.

Of particular relevance to the present report is a report by Sanders (2001) in which he describes training techniques for digital skills on FBCB2 and associated learning principles. These learning principles (see Table 2) were derived from the three theories of learning described above. In addition to describing these training techniques, he attempted to address questions about when certain training techniques would be most useful. According to Sanders, behaviorist techniques would be best suited to basic procedural tasks but would not be well suited for more complex decision-making tasks. Cognitive techniques would be best suited for training declarative tasks and although they may take longer than behavioral techniques for training procedural tasks, he suggested that cognitive techniques would result in better retention of such tasks. Finally, Sanders suggested that constructivist techniques would be best suited for training ill-defined tasks such as decision-making at the brigade staff level.

The learning principles and training techniques described by Sanders (2001) reflect the convergence of principles described above. For example, as can be seen in Table 2, all three theories promote training techniques that emphasize active practice of the task being learned (e.g., emphasize hands-on practice, conduct guided demonstration, and emphasize active, participative learning). Many of the training techniques described by Sanders were observed in the current research.

Table 2
Learning Principles and Associated Training Techniques

Learning Principle	Training Technique
Behaviorist Theory	
Associate unique stimuli with responses	Point out interface features; use memory aids
Employ modeling to shape behaviors	Perform demonstration of correct steps
Use deliberate practice to foster learning	Emphasize hands-on practice opportunities
Apply reinforcement to impact performance	Provide informative feedback on performance
Cognitive Theory	
Organize material for easy assimilation	Explain learning purpose, path and mnemonics
Actively involve learners in learning process	Conduct guided demonstration (participative)
Create associations with existing knowledge	Relate material to general or specific knowledge
Promote deep processing of information	Relate new material to previous content
Constructivist Theory	
Encourage self-constructed understanding	Emphasize active, participative learning
Emphasize learner control of material	Accommodate learner concerns and needs
Provide higher order learning context	Integrate prior tasks/skills in practical exercise
Use good coaching to build expertise	Provide expert coaching during exercises
Focus assessment on transfer of skills	Apply or practice skills in new situations

The strengths and weaknesses of the training techniques described by Sanders are echoed in other literature as well. For example Ertmer and Newby (1993) state that both learner abilities and the cognitive demands of the task to be learned are important for choosing the best suited training techniques. They report that novices generally benefit more from training that is highly structured such as would be derived from behavioral or cognitive theories. On the other hand, when the learners are already proficient at some tasks, constructivist techniques may be more beneficial for training higher order decision-making skills. Similarly as the level of cognitive processing required by the task increases, principles employed should move from behaviorist, to cognitive, and then constructivist (Ertmer & Newby, 1993).

Dimensions like learner abilities and the cognitive demands of the task being trained have been found to be relevant for determining useful training techniques for digital skills (Goodwin, 2006; Wampler et al. 2006). For example, a recent investigation (Childs, Blankenbeckler, & Dudley, 2001; Childs, Schaab, & Blankenbeckler, 2002) found constructivist principles worked well for acquiring and retaining skills among relatively advanced operators of two ABCS systems: ASAS and AFATDS. Using those principles enabled students to cover more material in less time than those who learned with traditional (mainly cognitive) methods, yet students did not perceive an increase in workload.

Dyer, Singh, and Clark (2005) assessed the applicability of using different computer-based training approaches for learning selected digital skills applicable to wearable computer systems used by ground Soldiers. Results reinforced the need to tailor training to the target population, especially when the population is diverse and common skills must be acquired. Results also suggested that presenting the same digital skills training to all personnel was not the most efficient, nor the most effective, nor the most motivating.

In illustrating how to train the use of digital systems with ground Soldiers, Blankenbeckler, Livingston, Dublac, Riffe-Seckinger, Swinson, and Dyer (2006) published sample training plans for one individual and one collective task. The report included suggestions and ideas for training that are directly applicable to other digital skills and tasks. One approach derived from cognitivist principles recommended that that trainers relate digital tasks back to the way the Soldier would have previously done it manually.

The present report is in many ways an archeological exercise in which the learning principles underlying digital instruction in the Army were uncovered and examined. The underlying learning principles were uncovered by measuring the training techniques and classroom activities of digital instructors. The purpose of this research effort was not to critique individual instructors but rather to examine trends across a variety of training sites and courses (MCS, ASAS, AFATDS, and FBCB2) including both operator and familiarization courses to gather and disseminate lessons learned and to recommend best practices.

Technical Objectives

Army units, from light to heavy and SBCT, already have or can expect to receive ABCS equipment. Formal operator training on the systems takes place in classroom settings. Units face a number of training challenges including expanded training requirements, disparate ABCS components, personnel turnover, a unit's deployment cycle, installation support taskings, and limited funds for training (Johnston, Leibrecht, Holder, Coffey, & Quinkert, 2002). Confronted by tight budgets, increasing use of digital systems at lower echelons, and the typically short time available to train personnel, the Army must improve its digital training methods. The methods must ensure the most efficient and effective training—individual, collective and sustainment—to enable units to perform at high levels.

To generate recommendations for improving the effectiveness of digital training in the Army, the objectives of this research were to first identify the learning principles and training techniques currently used to teach system operator skills and then evaluate those practices in light of current research. A secondary objective was to identify and share innovative training techniques developed by digital trainers.

Method

Overview

Within the ABCS family of systems, the research focused on FBCB2, MCS, AFATDS, and ASAS-Light (ASAS-L). The research team targeted two installations where digital training courses are taught—Fort Hood, Texas and Fort Benning, Georgia. An observation protocol was developed that focused on learning principles and training techniques. The observation sessions yielded data on the training environment, instructional activities, and training techniques in use.

Selection of Classroom Activities and Training Techniques

A key step in preparing to develop an observation protocol for collecting data was to select the classroom activities (e.g., lecture, video, guided demonstration) and training techniques (e.g., emphasize practice, relate material to military knowledge) to record. Selections were guided by the theoretical foundations cited in the *Introduction.*

Based on previous observations of digital training, the research team realized that only selected classroom activities are typically employed. As a result, many of the general classroom activities addressed in U.S. Army Training and Doctrine Command (TRADOC) Regulation 350-70 (TRADOC, 1999) did not apply to the process for investigating contemporary ABCS training (see Appendix B for full list of training methods). The list of classroom activities selected for observation appears in Table 3.

Table 3
Classroom Activities and Techniques Selected for Observation Purposes

Activity	Description
Lecture	Oral presentation of information, typically accompanied by slides
Video	Film-based presentation of real-world scenes and/or animation
Demonstration	Illustration of steps/actions by demonstrator (students observe only)
Guided Demonstration	Performance of steps/actions by demonstrator (students replicate)
Practical Exercise	Scenario-based event requiring application of skills and knowledge
Review	Retrospective summary or recapitulation of key learning points
Test	Formal measurement of learning by means of quizzes, exams, etc.
Break	Temporary suspension of formal learning activities
Technique	**Description**
Emphasize practice	Provide repeated opportunities to perform tasks and correct errors
Check learning progress	Assess learning via questions, feedback, and performance monitoring
Point to screen prompts	Point out elements in slides or ABCS screen displays to guide learning
Use memory aids	Provide memory prompts and mnemonics to facilitate recall
Provide purpose and path	Specify course benchmarks or topics, and maintain path awareness
Relate to military operations	Put system functions in context of military knowledge or operations
Relate to general knowledge	Link system functions to general knowledge of computer capabilities
Relate to previous content	Build on knowledge and/or skills covered earlier in the course
Respond to learners	Provide information to satisfy student questions or requests
Encourage active learning	Promote student involvement by means of instructor's challenges

Ten specific techniques were selected for observation. They were selected based on other research reports (Dyer, Singh, & Clark, 2005; Sanders, 2001) and were activities that we believed could be recorded in real-time with a high degree of reliability. They also represented the different theoretical perspectives discussed in the introduction and covered the majority of instructor activities though the list was not considered to be comprehensive. Observers had space on the observation form to describe all instructor activities, whether they were included on the list of activities or not.

Content and Design of Observation Form

The observation form consisted of three parts, and a copy appears in Appendix C. Part I of the observation form captured an assortment of class details. Basic information included the location of training, digital system being trained, software version being used, the number of students and instructors, number of digital systems, and general description or diagram of the training site. The observer noted the total scheduled duration of the training course as well as the specific training period being observed.

The structure of Part II facilitated the observer's recording of all activities during the training period. A time sampling procedure was used in which activities, training techniques, and other instructor behaviors were tallied in 5 minute blocks. Part IIA was primarily a chronology of training activities. A quick reference table at the top of each page provided a code for every classroom activity and training technique that represented the learning principles. Table 4 lists the quick reference codes. Descriptive definitions of the training techniques can be found in Appendix D.

Table 4
Reference Codes Used in Data Collection

Activity Code	
LEC – **Lec**ture	**PE** – **P**ractical **E**xercise
VID – **Vid**eo	**REV** – **Rev**iew
DEM – **Dem**onstration	**TEST** – Quiz, Exam, etc.
G/D – **G**uided **D**emo	**BRK** – **Br**ea**k**

Training Techniques	
EA – **E**ncourages **A**ctive learning	**RG** – **R**elates to **G**eneral knowledge
EP – **E**mphasizes **P**ractice	**RL** – **R**esponds to **L**earners
LC – **L**earning **C**heck	**RM** – **R**elates to **M**ilitary operation
MA – Uses **M**emory **A**ids	**RP** – **R**elates to **P**revious content
PP – **P**urpose and **P**ath	**SP** – Points out unique **S**creen **P**rompts or cues

In addition to the appropriate codes and 5-min blocks, the observer described the topics covered during each block and the instructor/student behaviors. A sample of a completed form (Part IIA) appears in Figure 1. This example was also used during the train-up process for the observers to help ensure consistency in the coding process. As shown in Figure 1, multiple activities and multiple learning principles could be coded in each 5-min block.

Num	Activity Code	Time	Description of topics covered and instructor/student behaviors	Training Technique
1	LEC	0815	Reviewed what they would cover for the day and reminded them of upcoming PE	PP
			Told students to power up systems, answered questions from students	RL
2	G/D	0820	Instructor provided steps to build 3D maps. Two students asked clarifying questions.	SP, RL
		0825	Cont G/D to 3D maps. Stopped multiple times to answer student questions.	SP, RL
			Appears to be a problem with workstations. No AI is present so instructor is troubleshooting.	RL
3	DEM	0830	Nobody can build 3D map so instructor just demonstrated. Explained operational uses.	SP, RM
4	G/D		Began a G/D to locate and select a map. Instructor had to help some students properly configure their machines.	SP, RL
		0835	Continued G/D on selecting a map	SP

Figure 1. Sample of completed data collection form, Part IIA.

As can be seen in Figure 1, the chronology maintained in the data collection form revolved around activities (i.e., lecture, guided demonstration, practical exercise, etc.). Each activity observed was numbered sequentially. Using a time-sampling procedure, the code for each activity observed during a 5-min block was entered. A description of the content being covered during the block was captured, along with noteworthy student and instructor behaviors. The final column of the chronology form called for entering the code for each training technique that occurred during the block. The time resolution of the form was 5 minutes for any instructional activity and training technique. That is, every activity and training technique that occurred within a 5-min block was counted once, but additional occurrences in the same block were ignored. The observer's instructions (see Appendix D) explained the recording rules that every observer was to follow.

Numerous practical exercises and demonstrations were expected in the ABCS courses. To capture detailed information during practical exercises, and thereby gain a clearer picture of how this type of training was conducted, Part IIB of the form facilitated recording of exercise activities. The form was laid out for recording the type of exercise, the exercise context, how the instructor monitored progress, whether peer coaching was observed, the number of repetitions of the same exercise, and additional explanatory comments.

Four types of practical exercises were cued on the observation form. These represented increasing levels of challenge to the students. As seen in Table 5, the exercise types were guided exercise, repetition of demonstration, new situation, and integration of prior tasks. The guide for observers (Appendix D) included the descriptions presented in Table 5.

Table 5
Types of Practical Exercises Cued in the Observation Form

Exercise Type	Description
Guided exercise	The instructor leads the students through the procedures
Repetition of demonstration	The instructor demonstrates, then the students repeat the steps
New situation	The students repeat the demo but with slight variations
Integration of prior tasks	The students apply skills practiced in earlier course activities

The observation form cued three kinds of practical exercise context: military operations (e.g., mini-scenario), job relevant (not necessarily associated with an operation), and arbitrary context (e.g., send a free text message with your name). The form also cued three techniques for monitoring student progress: querying students to obtain feedback, observing students by the instructor, and observing students by the assistant instructor(s).

Part III of the form contained three sections. The first section posed questions about how the instructor presented the course objectives and assessed student proficiency. The questions in the second section dealt with the end-of-course assessment, and the third section contained a couple of summary questions.

An observer guide was developed and discussed with all observers to help promote consistency in data recording. The guide described the training techniques, defined the exercise types, explained the time sampling procedure, and offered tips for answering the general questions. The guide (see Appendix D) included an example of a completed observation form (Part IIA).

Three observers pilot tested the data collection form prior to conducting observations. They employed draft versions of the form while observing ABCS training courses at Fort Hood and Fort Benning. The trial observations surfaced issues and questions that the investigators worked collaboratively to resolve. The form was revised based on feedback and resolution of issues from the pilot tests. The final version of the form was the product of two rounds of pilot testing and revision. Additionally, completed data collection forms were monitored as the courses were observed to make sure that they were properly filled out by the observers.

Observation Procedures

The observation plan called for gathering data from a variety of digital training courses to provide a representative sample of the instruction currently being conducted. At the time of the research effort, the bulk of digital training was taking place at Fort Hood, TX, in the Battle Command Training Center (BCTC). Digital training at the BCTC includes the entire ABCS family, and courses vary from a few days to two weeks in length. In order to gather training data on multiple systems at different locations within the constraints of the research project, a sample of courses from two locations was selected. Table 6 summarizes the eight ABCS courses observed during this project. All courses were geared for ABCS Version 6.4 software.

Table 6
ABCS Training Courses Observed

Location	Course	Training Audience	Duration	Observed
Fort Hood	MCS	Operators	5 days	4 days
	AFATDS	Operators	10 days	4 days
	ASAS-L	Operators	10 days	4 days
	FBCB2 #1	Operators	6 days	3 days
	FBCB2 #2	Operators	6 days	3 days
Fort Benning[a]	MCS	Leaders	2 days	2 days
	FBCB2 #1	Leaders	2 days	2 days
	FBCB2 #2	Leaders	2 days	2 days

[a] Orientation training for students attending the Infantry Captains Career Course (MCS), the Mechanized (Mech) Infantry Leaders Course (FBCB2 #1), and the Advanced Noncommissioned Officer Course (FBCB2 #2).

Four subject matter experts collected data, two at Fort Hood and two at Fort Benning. Three of the observers were retired Army personnel with experience using ABCS systems and training digital skills. The fourth observer was a behavioral scientist with ABCS training. Each of the four observers had experience observing classroom training in Army schools and/or training centers.

For the two-day courses a research team member observed every day of classes. In the case of the longer courses approximately half of the days were observed, with the general intent of sampling the first, middle and end (preceding the final exam) of the course. The observation plan called for bypassing formal test sessions because they were expected to yield relatively low payoff with respect to describing the instructional strategies reflected in the courses.

A standard procedure was used for observing each course. The observer met with the instructor prior to training to explain the purpose and role of the observation and to gather some course information. A sign-in sheet captured prior digital training or operating experience and the duty position of each student. The observer was typically present for the first and last day of the course in addition to one or two days in between, depending on the course length. The amount of training observed for each course is included in Table 6. The observer recorded data using the observation form. End-of-course and summary questions were completed following the final day of observations.

All observers participated in rehearsals to talk through the final observation form and to clarify the procedures. A senior investigator facilitated each rehearsal, leading the group through the observation process, discussing procedural consistency, and clarifying issues raised by the observers. An important aim of the rehearsals was to make the observation data more consistent across the sample of installations and courses. Even with the rehearsals there were differences between the observers in terms of recording style.

The observers captured data directly on the observation form, recording all data and notes by hand. The bulk of the data was descriptive or quantitative in nature, to minimize subjective influences and to support objective analysis. However, to leverage the observers' extensive training knowledge, some of the questions called for qualitative input. The intent was to capture robust data that could support not only characterizing what transpired during the training, but also drawing conclusions about how to improve digital training.

Training Audience

The courses observed were designed for two general types of students: active duty or contractor personnel selected to be ABCS operators or trainers, and Army leaders at company level and below enrolled in leader development courses. The sample of students was defined by those who attended the courses of interest at the targeted installations during the data collection period. The authors did not assume that the sample represented the population undergoing ABCS training throughout the Army. The FBCB2 system was represented heavily, because more FBCB2 courses are typically taught.

Table 7 summarizes the sample of students by ABCS system and course type. Of the 152 students, 70 were participating in ABCS operator courses while 82 were attending ABCS leader orientation courses. Among the 70 in the operator courses, 35 were contractor personnel; 24 were enlisted personnel; 8 were non-commissioned officers (NCOs); and 3 were commissioned officers (Lieutenants). Seven NCOs in the operator group were Sergeants (E-5) and one was a Staff Sergeant (E-6). The sample of 82 leaders was split almost evenly between commissioned officers (52%) and NCOs (48%). Among the leaders, the commissioned officers were all company grade (Captain and below) while the NCOs were Sergeants First Class (75%) or Staff Sergeants.

Table 7
Profile of Students in ABCS Courses Observed

Course	**# Students (Starting)**					**Prior ABCS Experience (% of Students)**	
						Single	**Multiple**
Operator Courses							
	Total	Officer	NCO	Enlisted	Contractor[a]		
MCS	12	--	1	--	11	25	75
AFATDS	11	2	--	1	8	11	67
ASAS-L	9	--	--	1	8	11	89
FBCB2 #1	19	--	4	15	--	11	11
FBCB2 #2	19	1	3	7	8	21	37
Orientation Courses							
MCS	32	32	--	--	--	31	28
FBCB2 #1	14	11	3	--	--	43	21
FBCB2 #2	36	--	36	--	--	39	28

[a] Contractor personnel are hired to support ABCS training and operations.

The pattern of students' experience with ABCS and related systems differed between the two categories of courses. About one-third of the leaders in the orientation courses brought some experience with a single ABCS system to their orientation training, while less than a third had prior training/experience with two or more ABCS systems. Among the students in the operator courses for MCS, AFATDS, and ASAS-L, as many as 100% brought prior ABCS experience to their system training, often with two or more systems. In the case of just the FBCB2 operators, the proportion bringing prior training/experience with two or more ABCS systems (23%) was similar to the pattern for the leaders.

The number of students in each class ranged from 9 to 36 (see Table 7). The class size for orientation courses averaged 27 students. The class size for operator courses averaged 14 students. The number of students in orientation courses partly reflected the size of the parent classes (ICCC, Mechanized Leaders Course, ANCOC), which is not a consideration in scheduling operator courses. Among the operator courses, the class size for FBCB2 courses (19 students in both cases) was larger than the size of the other ABCS courses (mean, 11 students).

Results

Classroom Training Environment

All observed courses occurred in a training center environment, in classrooms with a moderately flexible configuration. This section discusses the basic characteristics of the classrooms and the courses themselves.

Classroom basics. The courses observed during the project took place in five separate classrooms (three at Fort Hood and two at Fort Benning). Each student had his/her own workstation: a desktop or laptop computer that was running Version 6.4 of the operational software for the system of interest (MCS, ASAS-L, AFATDS, FBCB2). The workstations were connected to a local area network that emulated a tactical internet.

Each classroom contained one or two workstations for instructors, running the Version 6.4 software. An electronic projector displayed slides and other instructional materials on a large screen, and it could project a workstation display when desired. Every classroom at Fort Hood contained a functional ABCS software suite to represent systems other than the one on which students were being trained, but other systems were observed being used only during AFATDS training. In the AFATDS course the students were able to share information with other systems (e.g., FBCB2, MCS) for more realistic practical exercises. In the other courses, students were able to exchange digital information only with workstations of the same kind.

Typically present in the classroom were materials supporting the instructional process. These included class schedules, reference materials (e.g., MCS software user's manual), and job aids (e.g., AFATDS operator guide, ASAS Soldier's manual, FBCB2 pocket guide). The ASAS-L students received a three-ring binder containing the course schedule, classroom layout, student survey, and other materials. Printouts of the ASAS-L screen were posted on the walls of the classroom. In every course the instructors used handouts to guide formal practical exercises. Occasionally, the practical exercise materials were consolidated in a booklet.

In the FBCB2 operator courses at Fort Hood, a tactical classroom was also used for instruction. This classroom contained tactical versions of the FBCB2 systems, power supplies, communication components (e.g., Enhanced Position Location Reporting System [EPLRS]), internet controllers, and cables. These materials enabled the students to become familiar with the components of the real-world system. The tactical FBCB2 systems could connect with one another via a tactical internet (wireless).

Instructor-to-student ratio. In six of the eight courses, an instructor and assistant instructor handled each group of students from start to finish (Table 8). In one case (FBCB2 orientation #2), an instructor and two assistants appeared on Day 1 but one of the assistants was absent on the second (final) day. In the FBCB2 orientation #1 course, only one instructor was present throughout. In short, two instructors handled most of the classes regardless of the number of students.

Table 8
Ratio of Instructors to Students in ABCS Courses Observed

Course	# Instructors	# Students	Instructor-to-Student Ratio
Operator Courses			
MCS	2	12	1:6
AFATDS	2	11	1:5.5
ASAS-L	2	9	1:4.5
FBCB2 #1	2	19	1:9.5
FBCB2 #2	2	19	1:9.5
Orientation Courses			
MCS	2	32	1:16
FBCB2 #1	1	14	1:14
FBCB2 #2	3[a]	36	1:12

[a] Only an instructor and assistant instructor were present on Day 2.

The instructor-to-student ratio was computed by calculating the number of students per instructor. In one case (FBCB2 orientation #2) the number of instructors varied between the two days. In this case, the number of instructors (three) on Day 1 was selected as representative because it accounted for class start-up.

As Table 8 shows, the instructor-to-student ratios for the operator courses ranged from 1:4.5 to 1:9.5, with the higher ratios occurring for the FBCB2 operator courses. For just the operators of the battle staff systems (MCS, AFATDS, ASAS-L), the ratios were 1:6 or lower. For the orientation courses, the ratios ranged from 1:12 to 1:16. The consistently lower instructor-to-student ratios for the operator courses indicates more student-instructor interaction and is consistent with the greater depth of instruction and the longer course duration of these courses.

Course characteristics. The operator courses were designed to take military personnel with basic computer knowledge and experience to the point where they knew how to perform the basic functions of a specific ABCS workstation. Thus, they were organized around the functional features of the system at hand. The courses were geared to the home station environment with fixed classrooms in a learning center. It was expected that students would be scheduled at a time when they were soon to need the ABCS operator skills in order to perform their job in a tactical unit.

As seen in Table 6, the operator courses ranged from 5-10 days in duration. This included class start-up, primary instruction, testing, and course wrap-up. In all cases the schedule was laid out in consecutive days, excluding weekends and holidays. The various courses started on different days of the week (including Friday), with no fixed pattern. The extent to which each course focused on operating the user interface (vs. employing the system capabilities) was estimated at 100% for the battle staff systems, and 75-100% for FBCB2 (responses to question 1 of part IIIC of the data collection instrument). That is, while the courses taught students how to apply basic skills in practical exercises, the exercises did not place the students in operational settings using tactical equipment which is more the domain of a field exercise using trained operators. (As mentioned earlier, the classroom computers and network emulated the tactical systems and their connectivity.)

The criteria for operator course enrollment revolved mainly around duty assignment and need for the training. The programs of instruction specified proficiency standards in the form of pass-fail criteria for the scheduled tests. The criterion for passing was generally set at achieving an overall score of 70%.

The sequence of instruction followed a general-to-specific approach for the operator courses. Instruction usually began with a system overview of the ABCS family. System description and initialization came next, followed by readying the system for operations. An orientation to the system's main screen was typically followed by a series of learning activities organized around the layout and structure of system features and functions. This led to a drill-down cascade as the instructor followed menu options to deeper levels of functioning, then returned to a higher level to move on to the next major function or feature. The instruction occasionally used special practical exercises to focus on integrating and consolidating knowledge and skills across major functions. Each operator course ended with a capstone (final) exam, usually preceded by an omnibus review session.

The orientation courses were intended to give leaders enrolled in leadership courses (e.g., ICCC, Mechanized Infantry Leaders Course, ANCOC) a basic appreciation of a specific system, its capabilities and limitations. Accordingly, an orientation course was designed as an ABCS overview with limited hands-on exposure. The courses were geared to the institutional environment where a fixed classroom can be equipped with networked workstations. The students as a group attended the orientation when it appeared on the schedule.

As Table 6 showed, the orientation courses were two days in duration, including a brief lead-in, primary instruction, and final practical exercise. Two of these courses took place on back-to-back weekdays, but one course (FBCB2 orientation #1) was scheduled over four half-days and included a weekend break. The emphasis on operating the interface was estimated at 90-99%, indicating little attention to employment considerations. Although practical exercises gave the students an idea of how to apply basic skills, there was no exposure to tactical equipment in operational settings. As with the operator courses, the classroom computers and network emulated the tactical systems and their connectivity.

The qualifications for attending an orientation course were defined entirely by the selection criteria for the parent leader development course. The ABCS orientation was part of the larger course curriculum. The courses culminated with a practical exercise; there was no exam.

Instructional Activities in Classroom Training

As Table 4 showed, the set of eight classroom activities included conventional methods ranging from lecturing by the instructor to demonstration (with and without student participation) to testing by means of quizzes and examinations. These activities formed the categories used to classify instructor behaviors in the classroom. This section describes the instructional activities. As a general rule, results are presented separately for operator courses and orientation courses.

Basic activities. The methodology called for an observer to record every activity that occurred at least once in a 5-min block, using pre-defined codes. In the vast majority of cases the observers recorded a single activity code per time block. Occasionally an observer recorded two or even three codes in a 5-min block.

Table 9 summarizes key parameters of the data for the five operator courses. The second column of the table gives the total number of 5-min blocks observed during each day, excluding breaks. Within each main cell appear the number of blocks in which an activity was recorded and the same value expressed as a proportion of the total blocks observed for the day. Because a single block could contribute multiple counts (one for each different activity), the proportions in Table 9 (counts per block) may sum greater than 1.0 across a row.

By a sizable margin, the most frequent activity was guided demonstration. This activity took place in about half or more of the blocks during 17 of the 18 days observed, occurring in every block or nearly so during 3 of the days. Practical exercises accounted for one-third to half of the blocks during 6 of the 18 days observed. In the other days, practical exercises appeared in fewer blocks. Lecture occurred in about 30% of the blocks during 5 of the days observed, and in almost 90% of the blocks during one day. Lecture was infrequent (occurring in less than 10% of the blocks) during 11 of the days. Review of previous materials, including review of practical exercises, generally occurred infrequently, but it appeared in a quarter to a half of the blocks during 3 of the 18 days observed. It is of interest to note that on the two days when guided demonstrations were very infrequent, accounting for 16% or less of the blocks, practical exercises and reviews occurred instead.

Three activities were notable because of their absence during the observed classes. Video presentations occurred only twice in 18 days, appearing in only six blocks of time overall. The two videos involved footage of ABCS systems being employed in combat. A demonstration without students participating was never observed. Only one quiz was observed, in the form of a practical exercise during AFATDS training. (The sampling strategy deliberately avoided observing days with formal tests, but not informal tests such as quizzes. Testing and feedback are discussed later in this section.)

The last section of Table 9 sums the data across all courses to shed light on overall trends. In descending order from most frequent to least, the summed data showed the following hierarchy of instructional activities: guided demonstration, practical exercise, lecture, and review, with tests and videos occurring rarely. Instructor demonstrations without student involvement never occurred.

Table 9
Frequency (and Counts per Block) of Instructional Activities for Operator Courses

Day	Total Blocks	Lecture	Video	Demo	Guided Demo	Practical Exercise	Review	Test
MCS Operator Course (5-day schedule)								
1	60	2 (.03)	2 (.03)	0	44 (.73)	10 (.17)	2 (.03)	0
2	31	2 (.06)	0	0	23 (.74)	6 (.19)	0	0
3	54	2 (.04)	0	0	30 (.56)	20 (.37)	2 (.04)	0
4	64	0	0	0	10 (.16)	35 (.55)	19 (.30)	0
AFATDS Operator Course (10-day schedule)								
6	27	0	0	0	16 (.59)	6 (.22)	7 (.26)	0
7	53	1 (.02)	0	0	29 (.55)	20 (.38)	4 (.08)	20 (.38)
8	47	3 (.06)	0	0	22 (.47)	17 (.36)	5 (.11)	0
9	28	0	0	0	0	14 (.50)	14 (.50)	0
ASAS-L Operator Course (10-day schedule)								
1	64	21 (.33)	4 (.06)	0	34 (.53)	8 (.12)	2 (.03)	0
2	64	14 (.22)	0	0	53 (.83)	6 (.09)	0	0
5	44	7 (.16)	0	0	44 (1.0)	0	1 (.02)	0
7	63	0	0	0	43 (.68)	9 (.14)	12 (.19)	0
FBCB2 Operator Course #1 (6-day schedule)								
1	64	18 (.28)	0	0	44 (.69)	3 (.05)	3 (.05)	0
3	65	5 (.08)	0	0	31 (.48)	28 (.43)	6 (.09)	0
4[a]	48	14 (.29)	0	0	33 (.69)	3 (.06)	9 (.19)	0
FBCB2 Operator Course #2 (6-day schedule)								
1	67	18 (.27)	0	0	52 (.78)	6 (.09)	0	0
2	55	0	0	0	46 (.84)	6 (.11)	8 (.15)	0
5[a]	43	38 (.88)	0	0	30 (.70)	5 (.12)	2 (.05)	0
All Courses (Summed)								
All	941	145 (.15)	6 (.01)	0	584 (.62)	202 (.21)	96 (.10)	20 (.02)

[a] The entire class took place in a tactical classroom with standard issue equipment.

Table 10 presents the frequency of instructional activities for the three orientation courses. The data from the four half-days of the FBCB2 orientation #1 course were collapsed to two full days to make data from this course comparable with the data from the other courses. Guided demonstration played a role in more than half the 5-min blocks during 3 of the 6 days observed. Pure lecture also occurred in more than half the blocks during 3 of the 6 days. Practical exercises occurred with moderate frequency (nearly once per 3 blocks) in 3 of the 6 days, but rose much higher (appearing in 75% of the blocks) during Day 2 of the FBCB2 orientation #1 course

Table 10
Frequency (and Counts per Block) of Instructional Activities for Orientation Courses

Day	Total Blocks	Lecture	Video	Demo	Guided Demo	Practical Exercise	Review	Test
MCS								
1	49	5 (.10)	0	0	44 (.90)	Unk[a]	0	0
2	48	2 (.04)	0	0	30 (.62)	15 (.31)	1 (.02)	1 (.02)
FBCB2 #1[b]								
1[c]	47	24 (.51)	2 (.04)	0	18 (.38)	3 (.06)	0	0
2	44	0	0	0	11 (.25)	33 (.75)	0	0
FBCB2 #2								
1	56	32 (.57)	2 (.04)	1 (.02)	25 (.45)	16 (.29)	5 (.09)	0
2	50	30 (.60)	0	0	27 (.54)	16 (.32)	6 (.12)	0
All Courses (Summed)								
All	294	93 (.32)	4 (.01)	1 (.003)	155 (.53)	83 (.28)	12 (.04)	1 (.003)

[a] One practical exercise started as recording ended, so the number of blocks was not captured.
[b] The FBCB2 #1 course was scheduled in four half-day sessions.
[c] The first half-day occurred in a classroom without FBCB2 workstations.

Paralleling the operator courses, three activities were conspicuous because of their rare occurrence during the orientation classes. Video presentations (portraying the employment of ABCS systems in combat) took place only twice in eight sessions, while demonstration without student participation occurred only once (briefly during theFBCB2 orientation #2 course). Only one short test (a quiz) was observed (in the MCS orientation). However, in contrast with the operator courses, review of previous materials—including review of practical exercises—occurred rarely.

Some trends across days can be seen in Table 10. In two of the courses (MCS and FBCB2 orientation #1), guided demonstration decreased in frequency across days. Accompanying this decline was an increase in the occurrence of practical exercises.

The summed data in the last portion of Table 10 help reveal general trends for the orientation courses. In descending order from most frequent to least, the instructional activities exhibited the following rank order: guided demonstration, lecture, and practical exercise; review, testing, video, and demonstration occurred rarely.

As Figure 2 shows, the overall rates for the various activities were quite similar between the orientation courses and the operator courses (separated by less than 10 percentage points), except for lecture. The lower rate for lecture in the operator courses may relate to their longer durations (see Table 6) which would have left much more time for hands-on activities (see Table 7).

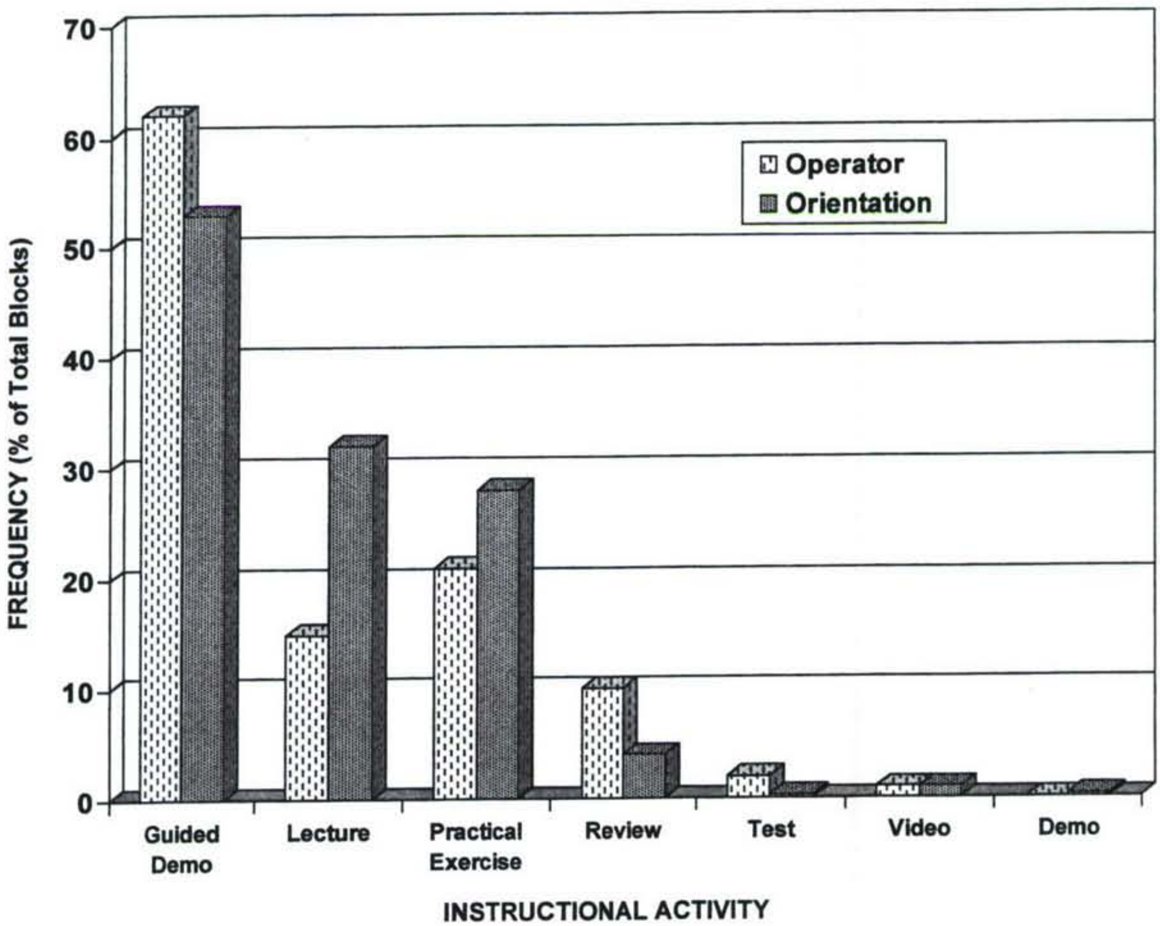

Figure 2. Overall frequency of the seven instructional activities, by type of course.

Guided demonstration normally involved verbal delivery of information (lecture) by the instructor as part of the means for guiding student attention and behavior. However, two of the four observers never recorded guided demonstration and lecture in the same 5-min block. This suggests that the distinction between lecture and guided demonstration was subtle at times.

In 4 of the 5 operator courses, some of the students created their own practice sessions by arriving early or working during breaks. In at least one of these courses the instructors suggested that the students arrive early, making themselves and the workstations available prior to the scheduled start of class. Those students taking advantage of these opportunities could benefit from personalized coaching by the instructor(s). It is possible that some students chose to work together in such circumstances, but nothing was recorded on this count.

In the courses sampled, "review" represented two types of activity: summary of key points at the end of a block of instruction, and review of performance just completed during a practical exercise or test. The investigators originally defined "review" with the first type of activity in mind, although it was subsequently considered the best category to cover post-exercise review as well. In the recapitulation case the activity focused on previous contents, while the post-exercise case relied heavily on feedback regarding performance during application of digital procedures.

Training aids. The instructors of the various courses used a variety of training aids as they executed the instructional activities. These training aids included traditional materials as well as hardware and software unique to the digital system at hand.

Reflecting conventional classroom methods, a package of instructional slides was used in every course. Conveying both text and imagery, the slides were projected on a large screen for the entire class to view simultaneously. Various static images of the user interface (screen captures) were displayed frequently in the slides. Video materials (e.g., scenes from Operation Iraqi Freedom) were displayed rarely, and when they did appear they served illustrative or motivational purposes.

Typically present in the classroom were materials to support the instructional process. These materials included class schedules, reference materials (e.g., MCS software user's manual, AFATDS operator guide), and job aids (e.g., ASAS Soldier's manual, FBCB2 pocket guide). In every course, the instructors used handouts to guide formal practical exercises. Occasionally the practical exercise materials were consolidated in a booklet.

The ASAS-L students received a three-ring binder containing the course schedule, classroom layout, student survey, and other materials. Printouts of the ASAS-L screen were posted on the walls of the classroom.

In all courses, the instructors could display an active ABCS user interface on the large screen display. The system thus displayed belonged to either an instructor or a student who was selected to sit at the demonstrator's station based on level of skill. The instructors used the "live screen" view in performing guided demonstrations of the user interface characteristics, operating procedures, or desired system end-states and outcomes.

In the ASAS-L course, each student received a compact disc (CD) containing exportable software. This enabled the students to study or practice with the system software on their own work or personal computer. This likely offered help after completion of the course, as well as extra practice opportunities during the course.

Simulation/Stimulation (SISTIM) capabilities were observed in the AFATDS classroom, where the system enabled students to interact with units/players up and down the fire support chain. The system came into play prominently during the command post exercise (CPX) near the end of the AFATDS course. The SISTIM capability was used to enhance classroom training with message and scenario (events generation) functions.

All of the classrooms at Fort Hood contained computer capabilities to represent ABCS systems other than the one being trained. The benefits of these capabilities would derive from creating a training environment more closely resembling the tactical world. However, they were observed being used only in the AFATDS operator course.

In the FBCB2 operator courses at Fort Hood, tactical systems were used to give students hands-on familiarization with the real-world system. Fourteen FBCB2 systems (black boxes) in a tactical laboratory included power supplies, communication modules (e.g., EPLRS), internet controllers, and cables. In some of the other courses (e.g., AFATDS), instructors passed around tactical components (e.g., Mission Data Loader, cables) for the students to inspect, using the components as simple training aids.

Practical exercises. Summary data for the practical exercises observed in all the sampled courses appear in Table 11, while detailed data appear in Appendix E. Integration of prior tasks was the most frequent type of exercise in the operator courses (44% of 18 definitive cases), but it occurred with only modest frequency (22% of 27 cases) in the orientation courses. Repeating a demonstration was moderately frequent in operator and orientation courses (used in 39% and 37% of cases, respectively). Practical exercises utilizing a new situation occurred frequently in orientation courses (37% of cases) but not in operator courses (11% of cases). Guided exercises were rare in both operator and orientation courses (6% and 4% of cases, respectively). Cases of missing data were excluded from the computation of these percentages.

Practical exercises in the operator courses were set nearly always in a job-relevant context (94% of cases). In contrast a job-relevant context (e.g., a task common to staff sections) materialized in only 30% of cases in the orientation courses, where a military operations context (such as a mission-related challenge) was most common (67% of cases). An arbitrary context (e.g., send a free text message) occurred rarely during practical exercises.

In both operator and orientation courses, the instructors monitored student progress and problems by directly observing them at work. The observation process typically involved the instructor (94% of cases in operator courses, 89% of cases in orientation courses) and his assistant(s) (100% of cases in operator courses, and 19% of cases in orientation courses). Querying students to obtain feedback occurred with modest frequency (19% of cases) in the orientation courses, but was never recorded in the operator courses. Peer coaching was very common, occurring in 62% of the cases in the operator courses and in 96% of the cases in the orientation courses.

The instructors often assisted students having difficulties during practical exercises. The help took the form of reminders, hints, answering questions, quickly reviewing procedures, and coaching individual students or small groups. Both the lead instructor and his assistant(s) typically participated in providing help. Combined with the peer coaching mentioned above, instructor coaching offered the students substantial support for learning.

A practical exercise in the operator courses usually consumed a substantial amount of time. An exercise usually involved four or more 5-min blocks—about 20 min or more (87% of the cases). In 43% of the cases, the duration exceeded six blocks (about 30 min), reaching 20 blocks (about 100 min) or greater in two cases. In contrast, an orientation course exercise was usually short in duration. The number of 5-min blocks in an exercise fell below four (about 20 min) in 81% of the exercises, and exceeded six (about 30 min) in only two events (8% of cases).

Table 11
Practical Exercises Observed in Operator and Orientation Courses

	Course	Total # PEs	Number of PEs per Type				
			Guided Exercise	Repeat Demo	New Situation	Integr Prior Tasks	Unk[a]
Operator Courses	MCS	8	0	6	0	1	1
	AFATDS	5	0	1	1	2	1
	ASAS-L	3	0	0	0	2	1
	FBCB2 #1	4	1	0	1	2	--
	FBCB2 #2	3	0	0	0	1	2
	Total	23	1	7	2	8	5
Orientation Courses	MCS	2	0	0	1	1	--
	FBCB2 #1	12	1	8	0	3	--
	FBCB2 #2	13	0	2	9	2	--
	Total	27	1	10	10	6	0

[a] Type information was not recorded by the observer.

In the operator courses, the faster students frequently finished the practical exercises early and usually were allowed to take a break. Other students sometimes continued working on exercises into breaks. In at least one course, the instructor suggested that students arrive early the next day to correct mistakes made in an end-of-day practical exercise. In only one practical exercise, of an orientation course did an observer indicate that some students finished early.

In the FBCB2 orientation #2 course, a practical exercise was used to compensate for forgetting that took place over a weekend break. In the Monday session, the instructor chose to repeat one of the practical exercises from the preceding (Friday) session, apparently to help the students resume their learning process.

Testing. Quizzes or tests were observed only four times during the 8 courses sampled in this project. On Day 6 of the AFATDS operator course, a 30-min practical exercise was labeled a "test" but no other details were recorded. In the same course (AFATDS), a 100-min "pop quiz" with scoring occurred on Day 7. The lead instructor provided a handout containing instructions for performing seven tasks, all relating to preparing for a fire mission. Some of the students took extra time to work on the quiz during the lunch break. A 15-min review of the results followed the quiz. A practical exercise on Day 7 of the ASAS-L course, which lasted about 45 min, was labeled a mid-course exam worth 100 points. In one orientation course (MCS), a 5-min "quiz" took place on the second day. In this case the students obtained a file from a shared folder, completed the brief quiz, and saved the completed file.

While no orientation course involved a final exam, every operator course included a final exam as a capstone event (Table 12). Given the observation strategy's avoidance of formal test sessions, the descriptive information for the final exams came primarily from copies obtained by the observers. Every exam included a hands-on component instructing the student to perform specific operating tasks and/or steps. While the exams emphasized hands-on performance, all of them included a written component except the ASAS-L exam. Grading of the exams relied on Go/No Go scoring, although scoring the ASAS-L exam involved awarding points. Two observers (AFATDS and FBCB2 courses) noted that the final exam allowed students to work with an open book and their class notes available.

Table 12
Summary of Final Exams Used in Operator Courses

Course	Written Component	Hands-on Component	Estimated Time
MCS	2 fill-in (recall) questions embedded in hands-on test	38 discrete tasks/steps organized in five parts (outcomes scored Go/No Go)	4 hrs
AFATDS	24 true-false + 8 multiple choice + 8 fill-in questions	More than 35 tasks/steps organized in eight parts (scoring unspecified)	5.5 hrs
ASAS-L	None	11 discrete tasks with outcomes scored by awarding of points	3 hrs
FBCB2 #1 & 2	6 fill-in (recall) questions scored Go/No Go	34 discrete tasks with outcomes scored Go/No Go	3 hrs

Training Techniques in ABCS Classrooms

As Table 4 showed, ten training techniques provided the framework for characterizing the nature of the classroom teaching methods. The theory-based techniques were intended to reveal how the instructor applied various learning principles. Guided by the observation form, the observer recorded the techniques that occurred in each 5-min block (one count for each technique observed one or more times). The tally process excluded breaks and, at the observer's option, it often excluded practical exercises. This section presents the data—both quantitative and qualitative—for the training techniques. The results are addressed separately for operator courses and orientation courses, with the data generally organized by the parent learning theories.

Frequency of training techniques. The training technique tallies from the five operator courses appear in Table 13. Each of the table's cells gives a frequency count and rate (count per block). The rate of occurrence was computed by dividing the frequency count by the number of valid 5-min blocks for the day. The valid observation blocks for each day excluded breaks and cases of missing data. Because single blocks often contributed multiple counts (one for each different technique), the proportions in Table 13 (counts per block) sum greater than 1.0 across a row.

Table 15
Examples of Training Techniques in Action

Technique	Instructor Behaviors
All Theories	
Emphasize practice	• Explain and reinforce the value of practice in acquiring and maintaining skills • Encourage students to practice on workstations before class or during breaks • Equip students with software CD enabling them to practice on their own
Check learning progress	• Ask questions (general and specific) to gauge students' comprehension • Observe students' demeanor for signs of confusion, misunderstanding, etc. • Observe students' workstations to verify correctness of procedures
Behaviorist	
Point to screen prompts	• Point with hand or pointer at elements on slides or ABCS screen displays • Verbally direct students' attention to elements on slides or screen displays • Direct demonstrator to highlight interface features or cues with cursor
Use memory aids	• Provide acronyms as memory joggers for procedural steps or sequences • Hand out user manuals, pocket guides, job aids, etc. • Refer students to user interface diagrams/screen prints in manuals or job aids
Cognitive	
Give purpose and path	• State or show learning objectives for course or class • Show or hand out schedule of classes, subjects, and/or topics • State or show where students are on the course path and what lies ahead
Relate to military operations	• Share personal anecdotes from own digital experience, deployment, etc. • Cite historical examples where ABCS did or could play a key role in combat • Explain how a function or capability can contribute to mission performance
Relate to general knowledge	• Use analogies from personal computers (PCs) to introduce ABCS features • Explain or illustrate how an ABCS feature or function mimics personal PCs • Compare or contrast an ABCS function or feature with one in the PC realm
Relate to previous content	• Explain or demonstrate how a procedure resembles one covered earlier • Compare or contrast a function or feature with one covered earlier • Remind students of knowledge or procedures learned earlier in the course
Constructivist	
Respond to learners	• Answer student questions by explaining, elaborating, or adding information • Tailor aspects of the instruction to accommodate student interests or concerns • Suggest ways students can obtain additional information or pursue interests
Encourage active learning	• Pass around ABCS tactical components (e.g., MDL, cables) for examination • Ask students to share their own insights/questions from training or operations • Designate student(s) to serve as demonstrators for the class

Conditions and activities in the classroom might be expected to influence the application of training techniques. Reexamination of data in Tables 13 and 14 speaks to this notion. During days where half or more of the time was spent in practical exercises, shifts in the dominant training technique usually occurred. In Day 9 of the AFATDS operator course, about half of which was spent in practical exercises (see Table 9), the most common training technique shifted from pointing to screen prompts to relating instruction to previous contents. And in Day 2 of the FBCB2 orientation #1 (75% spent in practical exercises, per Table 10), the dominant training technique shifted from pointing to screen prompts to responding to learners. Other examples where classroom characteristics, such as training audience composition, influenced the frequency of training techniques were mentioned in the preceding section.

When classes in the two FBCB2 operator courses moved to a tactical classroom, the dominant training technique did not change. However, the rate of occurrence sometimes increased for techniques involving direct interaction with students (checking progress, responding to learners, and encouraging active learning).

The observers' notes yielded several items that did not appear to fit any of the training techniques inventoried in this project. These items included instructor cautions (rule-like do's and don'ts), statements of system limitations, reliance on instructions in handouts to guide students procedurally, and instructor coaching.

Innovative techniques. One of the data capture items on the observation form asked the observer to describe any innovative teaching techniques observed in the classroom. This yielded the following:

- In the FBCB2 courses in both locations, the instructors selected one of the more capable students to serve as a demonstrator.
- Peer coaching was observed in all 8 courses, although it was unclear whether the instructors encouraged this or it emerged spontaneously, or both.
- When a student asked "how can I" or "what if" questions, one instructor had the individual try out the procedure in question (ICCC orientation).
- The AFATDS instructor team referenced some of their guided demonstrations to specific pages in a system pocket guide, apparently as a procedural aid.
- In the MCS orientation course, the instructor reinforced using the workstation by having students obtain quiz and exercise materials from a shared (networked) folder.
- The instructors of one of the FBCB2 operator courses asked students to answer questions on a practical exercise sheet as relevant topics were covered on Day 1.
- In addition to sharing their own combat experiences, the instructors of an FBCB2 operator course had the students share operational anecdotes.
- During one of the scenario-based exercises (a CPX during AFATDS training), the instructors role played external personnel (e.g., battalion commander).
- In the ASAS-L classroom, the instructors posted screen shots of various operating displays on the walls for ABCS ambience.
- In at least one course the instructors provided software on compact disc that enabled students to practice on their work or personal computers.

Integration of Data on Theory-Based Training Methods

The training techniques used to characterize instructional activities (Table 4) stemmed directly from the three learning theories. But other elements of the recorded data aligned with the learning theories, as well. For example, conducting guided demonstrations (one of the instructional activities) represented the cognitive learning principle of involving students in the learning process. When pertinent instructional activities and PE methods were added to the breakout of training techniques among learning theories, a more complete accounting of digital training methods emerged—as seen in Table 16.

Table 16
Summary of Theory-Based Methods Observed in ABCS Classrooms, by Type of Course

Theory	Method (Training Technique or Activity)	Rate (per Block)	
		Operator Courses	**Orientation Courses**
All (Provide Practice)	Structure exercises around repeat of demonstration (PEC)	.05	.10
	Emphasize hands-on practice (TT)	.01	.06
	Situate practical exercises in an arbitrary context (PEC)	0	.003
	Conduct guided practical exercises (PEC)	.002	.007
	Focus exercises on job duties (PEC)	.16	.08
	Integrate prior tasks/skills in practical exercises (PEC)	.11	.05
	Focus exercises on military operations (PEC)	.02	.20
	Frame exercises in new situations (PEC)	.01	.13
All (Provide Feedback)	Check progress of student learning (TT)	.21	.16
	Test learning by means of quizzes (IA)	.02	.003
	Provide peer coaching during exercises (PEC)	.06	.28
Behaviorist	Point out screen cues and prompts (TT)	.50	.43
	Use memory aids to cue recall (TT)	.004	.007
	Perform demonstration of steps (IA)	0	.003
Cognitive	Conduct guided demonstration (participative) (IA)	.62	.53
	Explain learning purpose and path (TT)	.36	.06
	Relate new material to military operations (TT)	.14	.38
	Relate new material to previous content (TT)	.12	.12
	Relate new material to general knowledge (TT)	.02	.06
Constructivist	Respond to learners' concerns and needs (TT)	.14	.22
	Review previous materials to strengthen learning (IA)	.10	.04
	Encourage active learning (TT)	.06	.03

Note: IA = instructional activity; TT = training technique; PEC = practical exercise code.

To convey the relative frequency of the various training methods, Table 16 gives the rates of occurrence for each type of course (operator and orientation). For training techniques and instructional activities, the rates are those presented earlier for "all courses" in Tables 9, 10, 13, and 14. For each parameter derived from PE data, the rate was computed by dividing the number of blocks tallied for the parameter (all courses) by the total number of blocks observed (minus the number of "nothing recorded" blocks)—essentially the same formula used for instructional activities and training techniques. Because the data collection sheet for PEs did not capture 5-min blocks, the number of blocks for an exercise was taken from the activity chronology sheet (see Appendix C). On balance, the rate values (expressed as counts per 5-min block) are comparable for all the methods included in the table.

It is good to keep in mind that many of the methods in Table 16 could occur at the same time. For example, while conducting a PE (instructional activity) an instructor might employ a guided exercise method in a job-relevant context involving peer coaching (all practical exercise codes). If all of these methods were recorded in the same 5-min block, all cases contributed to computing rate data in separate categories. As a result, summing the values down a column will yield a total substantially greater than 1.0. Thus, the rate values are merely relative indicators of the frequency of occurrence.

To partially compensate for uncontrolled variations between courses, including differences in recording styles of the observers, the investigators chose to focus this analysis on the results integrated across individual courses. This was not meant to trivialize the influence of situational factors, but rather to concentrate on global trends.

The data in Table 16 exclude certain instructional activities and practical exercise codes. Of the instructional activities, lecture and video presentation were omitted because they are common across all three theories of learning. Among the practical exercise codes, the procedures for monitoring student progress were ignored because it did not appear reasonable to align them with any one theory.

Table 16 contains no new data, except for the rates for the practical exercise codes. The data reveal consistencies between the two types of courses, as well as inconsistencies between them. The information in the table primarily sets the stage for considering patterns of classroom methods in the next section.

Discussion

Training Methodology

The three learning theories highlighted at the start of this report—behaviorist, cognitive, and constructivist—provide a useful framework for characterizing the state of ABCS training methods. They also offer a conceptual basis for discerning ways to improve the methods used to conduct digital training in the classroom. The integrated data from Table 16 help illuminate the patterns of instructional methods.

When looking across all instructional activities, training techniques, and practical exercise parameters, a couple clearly dominated the curriculum: guided demonstrations and pointing out screen cues and prompts (occurring in roughly 45-60% of the blocks). None of the constructivist methods in Table 16 occurred at high rates. That the instructors used fewer constructivist techniques is perhaps due to the fact that all courses we observed were intended to train novices. As Clark and Wittrock (2000) point out, these types of cognitive and behavioral techniques work better for novices than do constructivist approaches. Similar conclusions have been reached by other researchers (Ertmer & Newby, 1993; Goodwin, 2006; Sanders 2001).

Nevertheless, it would likely be beneficial to incorporate more constructivist techniques such as guided exploration into the digital training curriculum for several reasons. First, although the operator and orientation courses are designed for novices, many of the students attending them are experienced users of the systems. Further, by the end of a 40-80 hr course, it is likely that few in the classroom are novices anymore. For these reasons, it would make sense for instructors to consider using constructivist approaches, especially towards the end of the operator courses, given that these methods have been shown to have benefits over the traditional behavioral and cognitive approaches when training ASAS and AFATDS operators (e.g., Childs, Schaab, & Blankenbeckler, 2002; Schaab & Dressel, 2001). Second, guided exploration has been shown to be superior to guided demonstration as a training technique in a number of experiments even with what appear to be novices (see review by Goodwin, 2006).

The optimal place to insert more constructivist techniques would be during the practical exercises because it would require the smallest change in the program of instruction (POI). For example, having students integrate prior tasks and skills with newly learned ones without first being shown step-by-step how to do it would reinforce prior training and would require the students to master an ever increasing skill set. Additionally, instructors could avoid practical exercises that simply repeat prior guided demonstrations but rather, without prior guidance, have the students apply what they have learned to solve novel problems.

Eight of the methods in Table 16 revolve around practical exercises. These are repeating a demonstration, working in an arbitrary context, performing guided exercises, focusing on job duties, integrating prior skills, peer coaching, working on military problems, and practicing in new situations,. Only guided practical exercises and working in an arbitrary context occurred with negligible (near zero) frequency. Practical exercise differences between operator and orientation courses can be seen in Table 16, with orientation courses typically showing higher rates for the various exercise methods. The differences may reflect the somewhat greater frequency of practical exercises in orientation courses, different training audiences, and/or other factors. As an instructional bottom line, practical exercises are an essential part of digital training and can benefit from a variety of methods to enhance the learning outcomes.

Notable consistencies between operator and orientation courses are apparent in Table 16. In both types of courses, the rates were comparable for at least thirteen of the nineteen methods tracked. The most frequent techniques—guided demonstration and pointing to screen cues—were the same in both cases. Similarly, the least frequent methods were the same in the operator and orientation courses—demonstration, practicing in an arbitrary context, guided practical exercises, and using memory aids. Where inconsistencies surfaced, they usually represented relatively narrow differences. Of course, the pooled results in Table 16 may underestimate differences across courses or instructors. But the consistencies suggest that there were common threads at work in incorporating learning principles into the POIs and their implementation. Whether the common threads can foster insights on the relative value of the various training methods will depend on further investigation.

Coaching by both instructors and peers was observed in most of the courses. Peer coaching during practical exercises occurred with moderate frequency (once every four blocks overall) in orientation courses and low frequency (less than once every ten blocks) in operator courses. The lower frequency in operator courses probably reflects the less frequent occurrence of practical exercises and the students' general lack of expertise on systems other than FBCB2.

It may also reflect differences in the way that officers and NCOs interact and the way that junior enlisted interact. The leaders attended the orientation courses and the junior enlisted attended the operator courses. In part, it is possible that coaching served as a sort of remedial training when students lacked some of the prerequisite knowledge and skills. Wampler et al. (2006) noted that instructors who pre-test students can reduce the need for coaching or remedial training by structuring and presenting the materials more effectively. However, given the diverse audiences and compressed schedules of ABCS courses, coaching appears to be a valuable learning facilitator.

A number of the training methods in Table 16 occurred rarely (in less than 5% of the blocks or so). When looking at individual courses by days, some techniques were completely absent in the classroom. However, the low frequencies do not necessarily mean a given method has no place or value in the digital classroom. The merit of a candidate training technique depends on the learning objectives, training audience, time available, equipment on hand, student aptitudes and abilities, instructors available, and other factors. Thus, a low rate of occurrence should not deter an instructor from considering a particular technique. In fact, low density training methods may represent opportunities to increase the variety of learning experiences in classroom sessions. For example, instructors almost never demonstrated a task while the students merely observed. If the guided demonstration is the first time a student is seeing a task performed, that student's attention is divided between observing what the instructor is doing and trying to mimic it on his or her own system. This leaves little mental reserve to process or encode the steps being performed and consequently may result in faster skill decay.

It would be erroneous to conclude on the basis of the current research that demonstrations are never used when training software systems. The specific techniques applied may depend highly on the training conditions. As documented by Dyer and Tucker (2007), demonstrations were a common instructional technique during the New Equipment Training (NET) for the Land Warrior (LW) system. Demonstrations were then followed by PEs. Differences between the results in the current research and the LW NET could reflect instructor differences or the fact that it is difficult for a Soldier to operate the LW equipment he is wearing and simultaneously attend to procedures being demonstrated. In addition, during NET the classes were large, approximately 100 students, increasing the difficulty of insuring the instructor's and each student's pace matched. However, it should be noted that the demonstration technique has been observed in other LW training, with smaller class sizes (e.g., 40 and 9 students, Dyer et al., 2000; Dyer & Wampler, 2002).

As seen in Table 16, the cognitive method of relating instruction to general knowledge was absent or nearly so in most courses. The consistency of the pattern across courses suggests that ABCS instructors did not find this technique useful or necessary, or that training developers did not consider the technique when designing and developing the course materials. The finding indicates that ABCS training is not capitalizing on relevant results reported by other researchers. According to Wampler et al. (2006), if the functions of a military digital system are similar to Microsoft Windows, e-mail, or internet applications familiar to Soldiers (Singh & Dyer, 2001, 2002), the instructor can leverage the similarities. Training observations and experiments have shown that Soldiers more readily learn to operate and understand how to apply new system software when Microsoft conventions are used directly or by analogy. Explaining steps and functions in relation to the software operations that Soldiers already understand makes it easier for them to grasp the training material.

In summary, the instructional approaches used in the digital training courses examined utilized a range of training methods but clearly favored some methods over others. As reviewed in Goodwin (2006) and also discussed by Wampler et al. (2006), greater utilization of techniques like guided exploration, integrating prior tasks/skills in PEs, relating information to general knowledge, and demonstrating tasks before having students mimic them would be likely to improve skill acquisition.

Program of Instruction

For each ABCS course observed, the documented instructional plan (syllabus, lesson plans, etc.) provided the blueprint for the classroom training. The POI set the framework for applying training methods and techniques. This subsection discusses various aspects of the POI in the context of the three major learning theories. The discussion is based primarily on the observational data, rather than the instructional plans and materials.

The behaviorist and cognitive principles of pre-assessing students to enable tailored instruction was not evident in any of the ABCS courses sampled. The instructors typically queried the students at the start of the course to get a feeling for their range of experience, using an informal process. The students varied considerably in their previous experience with ABCS and related systems. Some had no ABCS experience, while others had worked with two or more ABCS systems. The instructors appeared to identify the more advanced students, but this generally had no effect on the role assigned during the course (e.g., company executive officer) or other aspects of the training. Problems stemming from a failure to accommodate different experience levels were most evident during the practical exercises, when the time to complete the exercises varied considerably.

Although the courses were all designed for the novice, negating the need to pre-qualify the students, some form of diagnostic test at the start of a course could have been helpful. Such testing would enable instructors to tailor the training sessions (within limits) and take advantage of the students with ABCS experience. For example, if most of the students had previous ABCS experience, instructors might consider using more advanced practical exercises. On the other hand, if the class included advanced and novice students, instructors could either divide students into different groups based on experience level or match the more experienced students with less experienced students so that the former could help instruct the latter.

Most of the instructional activities provided the students hands-on experience with the system. Overall, the most frequent instructional activity was guided demonstration. In this activity the students participated by following the lead of a demonstrator. The next most common instructional activity, practical exercises, gave the students further hands-on experience while requiring them to apply what they had learned. The more passive instructional activities—video presentation, instructor demonstration, and review of materials—occurred very infrequently. As mentioned above, activities like demonstrating procedural steps could benefit students, especially novices, because it allows them to focus their attention on the steps being trained before they have to attempt them on their own system.

Practical exercises most often used a military operations context in the orientation courses, but a job-relevant context dominated in the operator courses. This difference may stem from gearing the orientation POIs to leaders, who bring substantial operational experience to the training. Leaders may expect greater operational realism in their training. Also, leaders attending professional development courses are not assigned to a specific duty position and will likely be assigned to a variety of different jobs upon completing the course. Therefore, a job-relevant context for orientation courses would be difficult to determine, while general military applications could apply to a wider audience.

Testing occurred only in the operator courses, where the POI called for evaluating students' basic proficiency. The tests were limited largely to final exams. The exams strongly emphasized hands-on performance, but they also included written questions in four of the courses. All of the tests were constructed around a job-relevant context rather than a military operations scenario. In contrast, leader orientation courses devoted negligible time to reviewing lessons and included no capstone practical exercise, with the exception of the FBCB2 orientation #1 course. The absence of defined proficiency goals and the limited time in the orientation courses most likely accounts for the lack of capstone exercises in these courses. The FBCB2 orientation #1 course differed from the other orientation courses in that it was taught by an active duty military instructor and the students were all training on Bradley Fighting Vehicle operations.

One observer noted the general lack of warfighting lessons learned in the MCS, ASAS-L, and AFATDS operator courses. This observation fits with the absence of military operational contexts in practical exercises of the operator courses. The observer suggested incorporating combat lessons learned into the instructional materials to illustrate the application and value of ABCS capabilities.

Training Environment

Some of this project's observation results dealt with the training environment found in the ABCS classrooms. This subsection discusses selected aspects that shaped the training environment, with an emphasis on implications for improving digital training programs.

The cognitive learning principle of organizing instructional information to facilitate processing calls for course outlines, content organizers, etc. (Sanders, 2001). In the current sample of ABCS courses the instructors typically distributed job aids and reference materials such as operator guides and user manuals. This occurred at different points in the various courses, both early and later. A good example of integrating job aids in classroom activities occurred when instructors referenced demonstrations to specific pages in a pocket guide. However, even when distributed early, the supplemental materials were not always integrated into the instructional process. Thus it appeared that instructors held differing views of the role that supporting materials play in the learning process (e.g., active support of learning vs. follow-on reference). Further, some of the materials appeared to be non-standard items. It might be useful for the digital training community to adopt standard job aids and references for each ABCS component, and to include guidelines for utilizing the materials in the POI.

The ability to project an ABCS interface display on a large viewing screen played a prominent role in every course. The workstation projected on the screen was usually the instructor's, but in some courses a student's workstation was also displayed. There were a couple of advantages to doing this. First, the instructor could use a laser pointer to indicate screen locations as he described options that needed to be selected. The laser pointer helped the students to more easily see the location of the relevant buttons, menus etc. Second, the instructor was able to move around the classroom, helping individuals who were having trouble.

On a related note, classes were routinely taught by both an instructor and an assistant instructor (AI). The role of the AI was to address questions and deal with system problems so that the instructor did not have to interrupt the instructional activities. In this regard, the AI was invaluable to the presentation of course material. The AI was typically very busy during the classroom sessions answering student questions and troubleshooting any system problems that occasionally occurred.

Simulation and stimulation tools were noted only during AFATDS training, where the fire support-focused SISTIM served to emulate calls for fire originating from FBCB2-equipped sources. The system enabled students to apply their AFATDS operator skills in a more realistic environment. The observers reported no simulation/stimulation tools supporting MCS, ASAS-L, or FBCB2 training. How much such tools might enhance the effectiveness of operator training in those courses is unknown, but the issue may be worth examining. Wampler et al. (2006) concluded that, as a general rule, simulations are best suited to honing the skills of trained personnel. However, they emphasized the importance of representing only the minimal essential aspects of the operational environment when training digital skills.

Instructional Innovation

Several instructional innovations were observed and several of these have already been described—for example, distributing reference materials and software or projecting a student's monitor on the overhead screen for demonstration. Other instructional innovations were observed. This subsection explores selected classroom innovations along with a few observers' insights.

Since students often bring previous ABCS experience to the operator and orientation courses, instructors could leverage that experience as an instructional resource. They sometimes did this by asking digitally savvy students to share their lessons learned; serve as tutors, coaches and demonstrators; contribute to class discussion sessions; and work collaboratively with less advanced students. Students with operational experience using the system in a combat theater were able to provide insights into how a system function can be valuable in certain conditions. Such testimonials helped to highlight the context and the importance of the skills being trained.

Expanding hands-on practice opportunities beyond those built into the training schedule was reasonably common on the part of the instructors. Students were often encouraged to spend time on the workstations before class started or after it ended. The ASAS-L instructors were more assertive in arranging extra practice by providing each student a CD containing software to run on work or personal computers. In at least the take-home CD case, the instructors clearly intended for students to engage in self-guided practice. Although such approaches seem to point to a need for more scheduled training time, they reflect the instructors' positive efforts to make the most of the existing course schedules.

One of the research team's observers suggested incorporating some of a unit's digital TACSOP (tactical standing operating procedures) into classroom practical exercises. This approach would work only if all of the students were from the same unit and only if the unit had an established TACSOP. Such an approach would also require the instructors to spend time familiarizing themselves with the TACSOP, but the training would help Soldiers to learn their unit's established digital operations procedures.

As in the AFATDS course, other classrooms were planning to gain the ability to feed classroom systems with data from a simulator. This simulated feed has the potential to add a whole new dimension to training exercises but the full potential of such a capability has not been realized for systems other than AFATDS. In lieu of such a simulated feed, the instructor of the Mechanized Leaders course created a series of related practical exercises that required students to exercise their skills as they would during the course of a mission. Although this low-tech, scripted approach is not as dynamic as a simulated feed might be, it exercises the same decision making and operator skills and therefore would be an excellent substitute until more sophisticated simulators become available.

Conclusions

The behaviorist, cognitive, and constructivist learning theories together provide a useful framework for investigating digital training methods. The learning principles associated with the theories are complementary, forming a comprehensive structure for conceptualizing and relating training activities, techniques and practices.

Training methods based on all three learning theories played substantial roles in the sample of ABCS courses observed. Some cognitive and behaviorist methods were represented more than constructivist methods. The use of cognitive and behavioral techniques was expected because these courses were designed for a novice audience. If instructors were to add constructivist techniques, the most logical place to add them would be practical exercises. For example, instructors could add guided exploration or other activities in which the students are given little guidance and are encouraged to solve problems on their own. In addition, cognitive and behavioral techniques such as integrating prior tasks and skills in practical exercises, relating information to general knowledge and a military context, and demonstrating tasks before having students mimic them are all techniques that could be better utilized to improve skill acquisition.

In addition, innovative instructional techniques were observed in classrooms. Instructors used experienced students as demonstrators and sources of insights into the operational benefits of system functions. Instructors also collected a variety of ancillary guides and/or software to give to students so they could continue to learn about the system after the course ended. Finally, one instructor orchestrated practical exercises to fit a sequence of events the trainees might encounter on an actual mission. Wider use of these techniques, when appropriate, would be expected to contribute to skill acquisition.

It is hoped that this report will encourage instructors and course designers to try new approaches to training digital skills. We would encourage instructors to try some of the recommended techniques and then use practical exercise performance or other appropriate measures to determine the effectiveness of those techniques. By following these steps, digital instructors should be able to improve their effectiveness and their students' proficiency.

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Appendix A

ACRONYMS AND ABBREVIATIONS

3D	3-dimensional
4ID	4th Infantry Division (Mechanized)
ABCS	Army Battle Command System
AFATDS	Advanced Field Artillery Tactical Data System
AI	assistant instructor
ANCOC	Advanced Noncommissioned Officers Course
ARI	U. S. Army Research Institute for the Behavioral and Social Sciences
ASAS	All Source Analysis System
ASAS-L	All Source Analysis System – Light
BCTC	Battle Command Training Center
BRK	Break
CD	compact disc
CPX	Command Post Exercise
DEM	Demonstration
DTIC	Defense Technical Information Center
EA	encourages active learning
EP	emphasizes practice
EPLRS	Enhanced Position Location Reporting System
FBCB2	Force XXI Battle Command Brigade and Below
G/D	guided demonstration
hr	hour
ICCC	Infantry Captains Career Course
IA	instructional activity
LC	learning check
LEC	lecture
MA	uses memory aids
MCS	Maneuver Control System
MDL	Mission Data Loader
Mech	Mechanized
min	minute
NCO	Non-Commissioned Officer
NR	nothing recorded by observer
PC	personal computer
PE	practical exercise
PEC	Practical exercise code
POI	program of instruction
PP	path and purpose
REV	review
RL	respond to learners
RG	relate to general knowledge
RM	relate to military operations

RP	relate to previous content
SBCT	Stryker Brigade Combat Team
SISTIM	Simulation/Stimulation
SP	screen prompts
TACSOP	Tactical Standing Operating Procedure
TRADOC	U.S. Army Training and Doctrine Command
TT	training technique
VID	video

Appendix B

METHODS FOR DELIVERING INSTRUCTION

Extracted from TRADOC Regulation 350-70, *Systems Approach to Training Management, Processes, and Products*, Appendix H.

Lecture	Panel discussion	Seminar
Conference (discussion)	Gaming	Student panel
Demonstration	Brainstorming	Study assignment
Practical exercise	Flight (dual or solo)	Test
Case study	Research / study	Test review
Guest speaker	Role playing	Tutorial

Appendix C

Observation Form

Observer: ________________

Date: ______________

Part I: Class Details

Data Collection Form

1. Institutional Course/Class: ________________________________
2. Location: (Installation) __________________________ (classroom #) ____________
3. Digital system(s) being observed: FBCB2, MCS, ASAS
4. Software version: ______________________
5. # of instructors: ___________ # of students: __________________
6. # of workstations: ____________________
7. Describe the training site (to include resources; draw a diagram of site below).

____

____

____

____

8. Duration of course (days/ hours) ________ Observation period: (from day/hour) ________ (to day/hour) ________

Diagram of site:

Part II: Instructional Activities and Practical Exercises

IIA. Activity Chronology

SHEET NUMBER: ____________
Observer: ____________
Date: ____________

ACTIVITY CODE	VID – video	DEM – demonstration
G/D – guided demo	PE – practical exercise	REV – review
BRK – break	TEST – quiz, exam, etc	LEC – lecture

Training Techniques	**MA** – uses **M**emory **A**ids	**RM** – **R**elates to **M**ilitary operation
EA – **E**ncourages **A**ctive learning	**PP** – **P**urpose and **P**ath	**RP** – **R**elates to **P**revious content
EP – **E**mphasizes **P**ractice	**RG** – **R**elates to **G**eneral knowledge	**SP**– points out unique **S**creen **P**rompts or cues
LC – **L**earning **C**heck	**RL** – **R**esponds to **L**earners	

Num	Activity Code	Time	Description of topics covered and instructor/student behaviors	Training Techniques

IIA. Activity Chronology

ACTIVITY CODE	VID – video	DEM – demonstration
G/D – guided demo	PE – practical exercise	REV – review
BRK – break	TEST – quiz, exam, etc	LEC – lecture

SHEET NUMBER: ___________
Observer: ___________
Date: ___________

Training Techniques	**MA** – uses **M**emory **A**ids	**RM** – **R**elates to **M**ilitary operation
EA – **E**ncourages **A**ctive learning	**PP** – **P**urpose and **P**ath	**RP** – **R**elates to **P**revious content
EP – **E**mphasizes **P**ractice	**RG** – **R**elates to **G**eneral knowledge	**SP**– points out unique **S**creen **P**rompts or cues
LC – **L**earning **C**heck	**RL** – **R**esponds to **L**earners	

Num	Activity Code	Time	Description of topics covered and instructor/student behaviors	Training Techniques

IIB. PE/Guided Demo Detail Sheet

SHEET NUMBER:___________
Observer: __________________
Date: ______

Num (from Chron-ology)	**Exercise Type**: • Guided • Same as Demo • New situation • Integrate prior tasks	**Exer Context**: • Military Ops • Job-relevant • Arbitrary	**How did instructor monitor progress?** • Asked for feedback • Observed Soldiers • Assistants observed	**Peer coaching observed?** Y / N	**# Reps of Same Exercise**	**Additional Comments**

Part III Start-of Course, Final Assessment and Summary Questions.

Observer: ____________
Date: ______________

IIIA Start-of-course questions

1. What level of proficiency on this system were students required to have before taking this course? (check all that apply)

__ No pre-requisite knowledge of the system was required

__ Students had to understand the following software attributes and/or functions ______________

____

__ Students had to have completed the following course(s): ______________________________

____

__ Other (e.g. exam) describe: ____

____

2. At the beginning of the course, how did the instructor communicate the training objectives (i.e. topics or skills to be covered)? List those objectives if they are not listed in your chronology.

3. At the beginning of the course, what were students told to expect for a final test?

Observer:_______________
Date: _____________

IIIB Final Assessment Description.

1. How did the instructor evaluate student proficiency at the end of the training session? (e.g., knowledge (exam), performance (PE), etc.)

   a. _____Test of knowledge (written exam)
   ____ Recall (students repeated what was taught in class)
   ____ Application (students applied what was taught to solve problems)
   ____ Other (describe: ____)

   b. _____Test of performance/skill (PEs)
   ____ Recall (students repeated tasks taught in class)
   ____ Application (students applied what was taught to solve problems)
   ____ Other (describe: ____)

   c. ____ There was no evaluation of proficiency

   Describe the PE/Test and Feedback (if possible, obtain a copy of the exam):

IIIC Summary Questions. (to be answered after each observation period).

1. What percent of this course covered operator (i.e. knobology) skills and what percent covered employment skills?

2. Was the material taught at an appropriate level of difficulty for the students? Did the students appear to be engaged?

3. Were there enough systems for all the students? Did hardware or software problems occur and if so did they impede progress in the class?

4. Were there any innovative teaching techniques that deserve special mention? If so, describe them.

SIGN-IN SHEET

Class Title:	Location:	Time:

Name & Rank	Unit	Duty Position & MOS	Received Prior Training on (check all that apply)	Used in Unit (current or past/ check all that apply)
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______
			☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______	☐FBCB2 ☐ASAS ☐AFATDS ☐MCS ☐ OTHER_______

Appendix D

INSTRUCTIONS TO OBSERVER

BACKGROUND: Shortfalls in digital skill proficiency exist in units today. Our goal is to identify means and methods to overcome these deficiencies. We must be able to determine the cause of the shortfall. Therefore, while conducting your observation, keep the following points in mind.

- Capture any and all information relevant to the project objective:
  "Identify learning principles in use and how to improve them."
- Observe – listen – record.
- Record objective data; note if an entry is based on opinion. We will assess the data later.
- Be unobtrusive; do not interfere.
- Record as much detail as possible; when in doubt, write it down.
  (We should be able to reconstruct a mental picture of what occurred.)

>> <u>The OBSERVATION FORM</u> is divided into 3 parts:

- Part I, Class Details
- Part II, Instructional Activities and Practical Exercises
- Part III, Start-of Course, Final Assessment, and Summary Questions.

Instructions for completing each section are below.

Part I, Class Details. The first page of the data collection instrument asks for details about the classroom. The questions are self explanatory.

Part II, Instructional Activities and Practical Exercises. Once the classroom instruction begins, there are two forms for recording instructional activities: the *Activity Chronology* form and the *PE/Guided Demo Detail Sheet.*

IIA, Activity Chronology. Use this form to record instructional activities as they occur, as follows:

Column 1 (Num) – Number the classroom activities sequentially on the chronology (use additional copies of the chronology page as needed). When the Demo Detail sheet is used, the activity number from the Chronology sheet should be entered in the first (Num) column of the Demo Detail Sheet.

Column 2 (Activity Code) – Use the codes at the top of the page to indicate the type of activity. If more than one line is needed to describe the activity, there is no need to write the activity code for each line.

Column 3 (Time) Note the time that begins each 5 minute observation period (see details of time-sampling observation procedure below).

Column 4 (Description/Topics covered) – This space should be used for detailed notes about the course content and student and instructor behaviors. Detail is important; it's better to write down too much than too little. Use this space to:

- Describe the topic or task being covered as defined by the instructor; note the steps.
- Note examples of the checks on learning employed.
- Capture examples of the learning principles.
- Provide examples of the student/student or instructor/student coaching or tutoring that takes place.
- Explain any linkage between the current activity/task and previous activities/tasks.
- Note if some steps/points had to be presented multiple times.
- Capture clarifying questions asked by students.
- Record other pertinent information that will assist in understanding what transpired during the activity.

Column 5 (Learning Principles) – Using the abbreviations in the table at the top of the chronology page, enter all relevant learning principles exemplified by the activity described on that line of the chronology.

The learning principles are described in more detail below:

- Points out screen prompts or cues, to guide responses: The instructor points out flashing numbers, grayed out buttons, screen text, etc. that cue the student about what action is needed.
- Emphasizes practice: The instructor indicates the importance of practicing the tasks to gain the required skill.
- Responds to learner statements: The instructor modifies the instruction in some way to accommodate a question or request from a student.
- Encourages active learning: In addition to PEs, the instructor prods students to actively process the material. For example by asking questions, giving students problems to solve individually or in small groups, or having students answer each others' questions.
- Presents purpose and path: The organization of the class material is made explicit to students via a table or graphic and/or an effort is made to explain the reason for the organization. Students are reminded of this organization and where they are in the order of topics throughout the class.
- Relates to military operation: The instructor relates the material to military operations or knowledge either by making an analogy *("Overlays function just like acetate overlays on a paper map")* or by describing how the software might be used during a military operation *("The next time you have to plan a convoy route, remember to use the CLOS tool.")*.
- Relates to general knowledge: The instructor relates the material to general knowledge about computers, etc. *"This is similar to typical e-mail, operates like normal Windows functions.")*
- Relates to previous content: The instructor relates the material to some previously covered topic or exercise.
- Uses memory aids: The instructor provides memory aids (such as PACS [PLGR, Antenna, Computer, Screen] to remember startup sequence for FBCB2) or related techniques.
- Checks learning progress: The instructor stays aware of students' progress by observing performance, asking questions; giving quizzes, etc.; provides feedback as appropriate.

IIB, PE/Guided Demo Detail Sheet. Use this form to record information during PEs (Practical Exercises) or Guided Demos. The fields of this form are described below.

Column 1 (Num) – Use this to record the activity number. This number should match the activity on the Num column of the Activity Chronology form. If multiple PEs or demos are conducted for a single "Activity", then list each separately on the PE/Guided Demo detail using 1a, 1b, 1c, etc.

Column 2 (Exercise Type) – Indicate the nature of the exercise. Options progress from easy to difficult.

- Guided means students repeat the actions of the instructor by following along step by step.
- Same as Demo means that after watching a Demo, students must repeat all the steps on their own.
- New Situation means that after watching a demo, students must repeat the steps but enter new information in some of the fields (e.g., different addressees, different SPOT contents, new overlay).
- Integrate Prior Tasks means that students must combine knowledge of tasks or information learned at different times during the class in order to complete the PE successfully.

Column 3 (Exercise Context) – Indicate whether an attempt is made to relate the exercise to a military operation, a job-relevant task (not necessarily associated with an operation) or some arbitrary action like "send a free-text message with your name."

Column 4 (How did instructor monitor progress?) – Describe the means used to monitor student progress.

Column 5 (Peer coaching observed?) – Indicate whether or not you observed peer coaching/mentoring.

Column 6 (# Reps of Same Exercise) – Tally how many times the exact exercise was repeated.

Column 7 (Additional comments) – Use this space to record any other relevant information.

Time-Sampling Procedure: To simplify the quantification of learning principles, we will use a time-sampling procedure in which we will note whether or not learning principles occurred within 5 minute intervals. During any given 5 minute interval, record a description of the content being covered and any relevant student and instructor behaviors in column 4. In column 5 (this can be done in real-time or even at a later time) note which learning principles were exemplified by the behaviors in each row of column 4 (see example Activity Chronology below).

Using this sampling procedure, you can aggregate instances of each learning principle. For example if an instructor spends 10 minutes in a guided demo explaining how to send an overlay, you would describe the content of what he was teaching but rather than tally the number of screen prompts he indicates you would simply note "SP" in the 5th column for each 5 min interval that the instructor was doing the guided demo. Likewise you would note any other learning principles observed and ideally each learning principle would have a description in the same row of column 4.

You may note more than one instance of any learning principle during a five minute interval especially if they are discrete and separated by other activities. For example, an instructor may end one guided demo and then spend a couple of minutes answering questions and then begin another guided demo within one 5 min observation interval. Go ahead and note "SP" when the first guided demo ends and then "LC" (learning check) as the instructor asks questions and then "SP as the next guided demo begins. It's okay to record learning principles at a higher level of precision than we will actually report them.

If an activity spans across two time intervals, for example if a guided demo lasts more than 5 minutes, you would briefly describe the guided demo in each interval that it occurs (using ditto marks is acceptable as long it's clear what they refer to) and also indicate any learning principle observed during each 5 minute interval that the guided demo spans.

You only need to complete one row of sheet IIB (PE Guided demo detail sheet) for each guided demo/PE.

To help clarify this procedure, see the example Activity Chronology below.

Part III, Start-of-Course, Final Assessment, and Summary Questions. There are three groups of questions in part 3. The start-of-course questions should be answered when observing the beginning of the course. The final assessment questions only pertain the assessment given at the end of the course. The Summary questions should be answered after each observation period.

It may be useful to talk briefly with the instructor just before the class begins to learn things like the learning objectives of the class or how the instructor intends to assess proficiency at the end of the class. Otherwise most of these questions should be addressed in the instructor's opening comments

Sign-In Sheets: Have the students complete the sign-in sheet. There is a space for them to provide their name and rank. This is so that the form can substitute for the instructor's sign-in sheet. If the instructor uses his/her own form, students may omit their name if desired. Make sure to Bring enough copies for the entire class.

IIA. Activity Chronology

SHEET NUMBER: 1
Observer: Jones
Date: 9-Feb, 2006

ACTIVITY CODE	VID – video	DEM – demonstration
G/D – guided demo	PE – practical exercise	REV – review
BRK – break	TEST – quiz, exam, etc	LEC – lecture

Training Techniques	MA – uses Memory Aids	RM – Relates to Military operation
EA – Encourages Active learning	PP – Purpose and Path	RP – Relates to Previous content
EP – Emphasizes Practice	RG – Relates to General knowledge	SP– points out unique Screen Prompts or cues
LC – Learning Check	RL – Responds to Learners	

Num	Activity Code	Time	Description of topics covered and instructor/student behaviors	Training Techniques
1	LEC	0815	Reviewed what they would cover for the day and reminded them of upcoming PE.	PP
			Told students to power up systems, answered questions from students.	RL
2	G/D	0820	Inst provided steps to build 3D maps. Two students asked clarifying questions.	SP, RL
		0825	Cont G/D to 3D maps. Stopped multiple times to answer student questions, appears	SP, RL
			to be a problem with workstations. No AI is present so instructor is troubleshooting.	RL
3	DEM	0830	Nobody can build 3D map so instructor just demonstrated. Explained operational uses.	SP, RM
4	G/D		Began a G/D to locate and select a map. Inst had to help some student properly configure	SP, RL
			their machines.	
		0835	Continued G/D on selecting a map.	SP
		0840	Continued G/D. stopped to repeat steps for a student. Reminded students there are	SP, RL
			multiple ways to accomplish this task. Asked students to describe alternatives.	RP, LC
5	G/D	0845	G/D on selecting "Battle Mode" and book marking maps. .Inst notes activities 2 - 5 are	SP, RP
			a review of previous day's work.	
		0850	Continued G/D. 1 student asked a question about sending bookmarks.	SP,RL
6	G/D	0855	Clean up system to prepare for PE. Used dual screens (PPT slides vs. System).	SP, PP

Appendix E

DATA TABLES FOR PRACTICAL EXERCISES

Table E-1
Characteristics of Practical Exercises Observed in Operator Courses

Purpose	No. Blocks	Type	Context	Monitoring	Peer Help
MCS Operator Course					
Practice system preparation	4	Repeat demo	Job relevant	Observation by instructor + assts	Yes
Practice message processing	5	Repeat demo	Job relevant	Observation by instructor + assts	Yes
Practice map operations	6	Repeat demo	Job relevant	Observation by instructor + assts	Yes
Practice map ops (cont'd)	6	Repeat demo	Job relevant	Observation by instructor + asst	NR
Practice tracking operations	14	NR	NR	NR	NR
Practice using MDMP-Asst	12	Repeat demo	Job relevant	Observation by instructor + asst	Yes
Practice collaboration	5	Repeat demo	Job relevant	Observation by instructor + asst	Yes
Practice cumulative skills	18	Integr prior tasks	Job relevant	Observation by instructor + asst	No
AFATDS Operator Course					
Practice configuring comms	6	New situation	Job relevant	Observation by asst instructor	No
Demonstrate skills (quiz)	20	Integr prior tasks	Job relevant	Observation by instructor + asst	No
Practice using collabor tools	8	Repeat demo	Job relevant	Observation by instructor + asst	No
Prepare for CPX	9	NR	NR	NR	NR
Practice skills in CPX	14	Integr prior tasks	Military ops	NR	NR
ASAS-L Operator Course					
Practice using address book	8	Integr prior tasks	Job relevant	Observation by instructor + asst	Yes
Practice message mgt	6	Integr prior tasks	Job relevant	Observation by instructor + asst	Yes
Practice database ops (quiz)	9	NR	NR	NR	NR
FBCB2 Operator Course #1					
Practice configuring equipmt	2	Guided exercise	Job relevant	Observation by instructor + asst	Yes
Practice building overlay	4	Integr prior tasks	Job relevant	Observation by instructor + asst	No
Practice cumulative skills	25	Integr prior tasks	Job relevant	Observation by instructor + asst	No
Disassemble/assemble equip	3	New situation	Job relevant	Observation by instructor + asst	Yes
FBCB2 Operator Course #2					
Practice system preparation	6	Integr prior tasks	Job relevant	Observation by instructor + assts	Yes
Reassemble hardware	4	NR	NR	NR	NR
Practice filling SINCGARS	2	NR	NR	NR	NR

Note: NR = nothing recorded by observer

Table E-2
Characteristics of Practical Exercises Observed in Orientation Courses

Purpose	No. Blocks	Type	Context	Monitoring	Peer Help
MCS					
Practice developing UTO	NR	Integr prior tasks	Job relevant	Queries by instructor	Yes
Practice building overlay	15	New situation	Military ops	Observation and queries	Yes
FBCB2 Orientation #1					
Practice creating address book	2	Guided exercise	Job relevant	Queries by instructor	Yes
Practice creating SPOT report	2	Integr prior tasks	Job relevant	Queries by instructor	Yes
Practice using address book	2	Repeat demo	Military ops	Observation by instructor	Yes
Practice creating folders	2	Repeat demo	Military ops	Observation by instructor	Yes
Practice sending Position Rpt	2	Repeat demo	Military ops	Observation by instructor	Yes
Practice creating overlay	5	Integr prior tasks	Military ops	Observation by instructor	Yes
Practice creating routes	2	Integr prior tasks	Military ops	Observation by instructor	Yes
Practice message mgt	8	Repeat demo	Job relevant	Observation by instructor	Yes
Practice creating reports	2	Repeat demo	Job relevant	Observation by instructor	Yes
Practice creating routes	2	Repeat demo	Job relevant	Observation by instructor	Yes
Practice creating overlay gps	2	Repeat demo	Job relevant	Observation by instructor	Yes
Practice creating overlays	6	Repeat demo	Job relevant	Observation by instructor	Yes
FBCB2 Orientation #2					
Practice starting systems	1	Repeat demo	Arbitrary	Observation by instructor	No
Practice clearing logs and Qs	1	Repeat demo	Military ops	Observation by instructor + asst	Yes
Practice system preparation	2	Integr prior tasks	Military ops	Observation by instructor + asst	Yes
Practice selecting maps	3	Integr prior tasks	Military ops	Observation and queries	Yes
Practice initializing maps	3	New situation	Military ops	Observation by instructor	Yes
Practice positioning icon	1	New situation	Military ops	Observation by instructor	Yes
Practice map operations	2	New situation	Military ops	Observation by instructor	Yes
Practice using Line of Sight	3	New situation	Military ops	Observation by instructor + asst	Yes
Practice creating address gps	3	New situation	Military ops	Observation by instructor	Yes
Practice using QuickSend	3	New situation	Military ops	Observation by instructor + asst	Yes
Practice message mgt	5	New situation	Military ops	Observation by instructor	Yes
Practice positioning on map	3	New situation	Military ops	Observation by instructor	Yes
Practice sending SPOT report	1	New situation	Military ops	Observation by instructor	Yes

Note: NR = nothing recorded by observer.